



88048168



# **Ecosystem Analysis at the Watershed Scale**

**Federal Guide for Watershed Analysis**

**Revised  
August 1995**

**Version 2.2**

**Portland, Oregon**



BLM LIBRARY  
RS 150A BLDG. 50  
DENVER FEDERAL CENTER  
P.O. BOX 25047  
DENVER, CO 80225

ID 88048168

USDA	USDI	USDI	USDI	National	National	Environmental
Forest	Bureau	Fish &	Bureau	Park	Marine	Protection
Service	of Land	Wildlife	of Indian	Service	Fisheries	Agency
	Management	Service	Affairs		Service	

---

**Date:** August 28, 1995

**To:** Field Managers and Forest Supervisors

**From:** Regional Interagency Executive Committee (RIEC)

Anita Frankel, Director, Forest & Salmon Group, Environmental Protection Agency

John E. Lowe, Regional Forester, R-6, Forest Service

Stan M. Speaks, Area Director, Bureau of Indian Affairs

Michael J. Spear, Regional Director, U.S. Fish & Wildlife Service

William Stelle, Jr., Regional Director, National Marine Fisheries Service

William G. Walters, Deputy Field Director, National Park Service

Elaine Y. Zielinski, OR/WA State Director, Bureau of Land Management

**California Federal Executives**

Ed Hastey, State Director, California, Bureau of Land Management

G. Lynn Sprague, Regional Forester, R-5, Forest Service

**Subject:** *Ecosystem Analysis at the Watershed Scale: Federal Guide for Watershed Analysis, Version 2.2*

Enclosed for your immediate use is Section I of the document: *Ecosystem Analysis at the Watershed Scale: Federal Guide for Watershed Analysis, version 2.2 (Federal Guide)*. This document was adopted by the Regional Interagency Executive Committee (RIEC) on August 3, with concurrence by the Intergovernmental Advisory Committee (IAC).

**Watershed Analysis Implementation**

Section I of the *Federal Guide* represents current direction in the evolution of an interagency watershed analysis process for the area covered by the Northwest Forest Plan (NFP). The process described in the *Federal Guide* will be used for new watershed analyses initiated by the Forest Service and Bureau of Land Management under the NFP after August 28. The watershed analysis process described in the *Federal Guide* supersedes the processes described in *A Federal Agency Guide for Pilot Watershed Analysis* (January 1994) and the *FY 1994-96 Watershed Analysis Guidelines* (June 1994). The *Federal Guide* does not supersede interim direction for implementing watershed analysis during the fiscal years 1994-1996 transition period, as described in the *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl* (ROD, p. 55-56).

**Federal Guide**

As a primary tool for generating information to implement ecosystem management, as directed in the NFP, watershed analysis is essentially ecosystem analysis at the watershed scale. The title of this interagency guide, *Ecosystem Analysis at the Watershed Scale: Federal Guide for Watershed Analysis*, reflects this concept. In its current form, the *Federal Guide* describes a

QH  
541.5  
.V3  
E285  
P95  
C.2

BLM LIBRARY  
RS 150A BLDG. 50  
DENVER FEDERAL CENTER  
P.O. BOX 25047  
DENVER, CO 80225



general process that need not be specific to the NFP; it could be applied anywhere that a landscape approach to watershed analysis is desired.

The *Federal Guide* was based on direction provided by the RIEC, recommendations from the IAC, and comments from a wide spectrum of agencies, governments, organizations, and publics. The document reflects work by the interagency Watershed Analysis Coordination Team (WACT), pilot and non-pilot watershed analysis teams, interagency workgroup members, peer reviewers, and other interested parties. As a result of this breadth of involvement, the *Federal Guide* has been improved over its predecessor in many ways. For example, the analysis process now includes seven "core" topics to ensure that all analyses demonstrate a basic understanding and knowledge of the watershed. The process has also been simplified, and now includes six concise and understandable steps that follow a more direct logic path.

Section I of the *Federal Guide* is organized in two parts. The first part is an overview of the analysis process, and includes: an introduction; a summary of the six-analysis steps; process considerations; technical considerations; relationships to other laws, regulations, processes, and lands; monitoring; core topics; and core questions. The second part of Section I describes each of the six steps for conducting ecosystem analysis at the watershed scale. The six steps lead investigators through a series of questions to characterize the watershed, focus the analysis on essential issues, describe and understand current and historical conditions and processes, interpret the results, and develop recommendations for subsequent action by responsible officials.

#### Future Additions to the Federal Guide

The *Federal Guide* at this time does not include Section II, Analysis Tools and Techniques or the Terrestrial Ecology Addendum from the March 24 draft of the *Revised Federal Guide*. The RIEC has committed to the issuance of Section II as a technical supplement to Section I of the *Federal Guide*. Section II is intended to serve as a technical supplement or "tool box" of analytical methods and techniques designed to help address various aspects of watershed analysis and Section I "core" topics. The goals of Section II are to: meet NFP goals, ensure scientific credibility, provide "methods and techniques," and provide for cooperation and coordination with other watershed analysis processes. We anticipate that we will incrementally issue Section II over the upcoming months as we develop or revise methods and techniques.

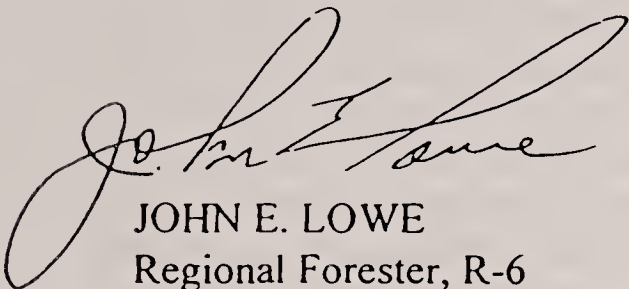
In the meantime, teams should continue to use any and all analysis methods and techniques that are appropriate to analyze issues in their watersheds. Modules from *A Federal Agency Guide for Pilot Watershed Analysis*, draft domains and modules from the March 24 review draft, methods and techniques from the draft Terrestrial Ecology Addendum, and modules from other analysis processes (e.g., Washington DNR process) may all have utility and can be used as appropriate.

#### Summary

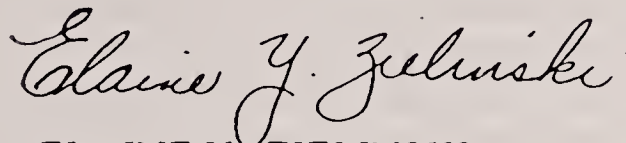
Watershed analysis teams, as guided by responsible officials, will continue to conduct watershed analysis to support informed decisionmaking in conformance with the NFP. All watershed analyses initiated after August 28 will be conducted in accordance with the *Federal Guide*; i.e., they will follow the six-analysis steps and address the core analysis topics. The level of detail



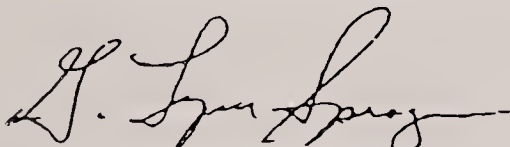
required to analyze the core topics and others will depend on the issues (events triggering the analysis and resource concerns) specific to each watershed. This will provide a consistent, logical framework for teams to conduct analyses and report their results. Analysis teams should use their collective professional expertise to produce scientifically credible watershed reports. The adequacy and success of analyses will, in large part, lie in the responsible official's ability to understand the results and apply them to subsequent decisions.



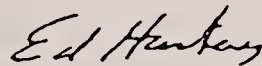
JOHN E. LOWE  
Regional Forester, R-6  
USDA Forest Service



ELAINE Y. ZIELINSKI  
Oregon/Washington State Director  
Bureau of Land Management



G. LYNN SPRAGUE  
Regional Forester, R-5  
USDA Forest Service



ED HASTEY  
California State Director  
Bureau of Land Management



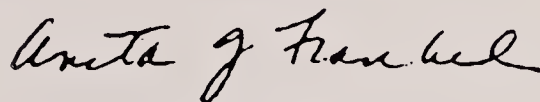
MICHAEL J. SPEAR  
Regional Director  
US Fish & Wildlife Service



WILLIAM STELLE, JR.  
Regional Director  
National Marine Fisheries Service



STAN M. SPEAKS  
Area Director  
Bureau of Indian Affairs



ANITA FRANKEL  
Director, Forest & Salmon Group  
Environmental Protection Agency



WILLIAM C. WALTERS  
Deputy Field Director  
National Park Service

Enclosure

465/ly







## Acknowledgment

This guide was completed under the direction of the Regional Interagency Executive Committee and the Intergovernmental Advisory Committee, representing the Forest Service, Regions 5 and 6, the PNW and PSW Research Stations; Bureau of Land Management, Oregon/Washington and California State Offices; Bureau of Indian Affairs; U.S. Fish and Wildlife Service; Environmental Protection Agency; National Marine Fisheries Service; Natural Resources Conservation Service; National Park Service; National Biological Service; the States of California, Oregon, and Washington; California, Oregon, and Washington Counties; the Intertribal Timber Council; Northwest Indian Fisheries Commission; and the California Indian Forest and Fire Management Council.

Many more agencies, governments, and organizations contributed to the diligent teamwork that led to production of this guide, including the U.S. Geological Survey, U.S. Army Corps of Engineers, the Research & Monitoring Committee, the Watershed Analysis Coordination Team, and the Regional Ecosystem Office.

This document was produced in cooperation with the Regional Interagency Executive Committee:



1. The following information was obtained from the  
Bureau of Land Management, U.S. Department of the Interior,  
Washington, D.C. 20540.  
2. The following information was obtained from the  
Bureau of Land Management, U.S. Department of the Interior,  
Washington, D.C. 20540.  
3. The following information was obtained from the  
Bureau of Land Management, U.S. Department of the Interior,  
Washington, D.C. 20540.



## Contents

<b>Part 1: Process Overview</b>	<b>1</b>
Introduction	1
Organization of This Guide	2
Summary of the Six-Step Process	3
Process Considerations	3
Technical Considerations	5
Relation to Other Laws, Regulations, Processes, and Lands	9
Monitoring	11
Core Topics	11
Core Questions	12
 <b>Part 2: Process</b>	 <b>15</b>
Step 1: Characterization	15
Step 2: Issues and Key Questions	16
Step 3: Current Conditions	18
Step 4: Reference Conditions	19
Step 5: Synthesis and Interpretation	20
Step 6: Recommendations	22
 <b>Watershed Analysis Report</b>	 <b>23</b>
 <b>Glossary</b>	 <b>24</b>
 <b>References</b>	 <b>26</b>





# Part 1: Process Overview

## Introduction

Watershed analysis is a procedure used to characterize the human, aquatic, riparian, and terrestrial features, conditions, processes, and interactions (collectively referred to as “ecosystem elements”) within a watershed. It provides a systematic way to understand and organize ecosystem information. In so doing, watershed analysis enhances our ability to estimate direct, indirect, and cumulative effects of our management activities and guide the general type, location, and sequence of appropriate management activities within a watershed.

Watershed analysis is essentially *ecosystem analysis at the watershed scale*. As one of the principal analyses for implementing the Aquatic Conservation Strategy (ACS) set forth in the Northwest Forest Plan (*Record of Decision (ROD) for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl* (USDA, USDI 1994)) it provides the watershed context for fishery protection, restoration, and enhancement efforts. The understanding gained through watershed analysis is critical to sustaining the health and productivity of natural resources. Healthy ecological functions are essential to maintain and create current and future social and economic opportunities.

Federal agencies are conducting watershed analyses to shift their focus from species and sites to the ecosystems that support them in order to understand the consequences of management actions *before* implementation. The watershed scale was selected because every watershed is a well-defined land area having a set of unique features, a system of recurring processes, and a collection of dependent plants and animals.

Watershed analyses are conducted by teams of journey-level specialists who follow a standard, interagency six-step process. The process is *issue-driven*. Rather than attempting to identify and address everything in the ecosystem, teams focus on seven core analysis topics along with watershed-specific problems or concerns. These problems or concerns may be known or suspected before undertaking the analysis or may be discovered during the analysis. Analysis teams identify and describe ecological

processes of greatest concern, establish how well or poorly those processes are functioning, and determine the conditions under which management activities, including restoration, should and should not take place. The process is also *incremental*. New information from surveys and inventories, monitoring reports, or other analyses can be added at any time.

Watershed analysis is not a decisionmaking process. Rather it is a *stage-setting* process. The results of watershed analyses establish the context for subsequent decisionmaking processes, including planning, project development, and regulatory compliance.

The results of watershed analysis can be used to:

- Assist in developing ecologically sustainable programs to produce water, timber, recreation, and other commodities.
- Facilitate program and budget development by identifying and setting priorities for social, economic, and ecological needs within and among watersheds.
- Establish a consistent, watershed-wide context for project-level National Environmental Policy Act (NEPA) analyses.
- Establish a watershed context for evaluating management activity and project consistency given existing plan objectives (e.g., ACS objectives).
- Establish a consistent, watershed-wide context for implementing the Endangered Species Act, including conferencing and consulting under Section 7.
- Establish a consistent, watershed-wide context for local government water quality efforts and for the protection of beneficial uses identified by the states and tribes in their water quality standards under the Federal Clean Water Act.

1. The first part of the document discusses the importance of maintaining accurate records of all transactions.

2. It is essential to ensure that all data is entered correctly and that the system is updated regularly.

3. The second part of the document outlines the procedures for handling customer inquiries and complaints.

4. It is important to respond to customers promptly and to provide them with the information they need.

5. The third part of the document describes the process for conducting regular audits of the system.

6. These audits are necessary to ensure that the system is functioning properly and that all data is accurate.

7. The fourth part of the document discusses the importance of training staff on the system and on customer service.

8. It is essential to ensure that all staff are familiar with the system and that they are able to provide excellent customer service.

9. The fifth part of the document describes the process for handling system downtime and for recovering data.



---

## Organization of This Guide

This federal guide is organized in two parts.

**Part 1** is an overview of the analysis process and includes an introduction; a summary of the six analysis steps; important process considerations; technical considerations; relationships to other laws, regulations, processes, and lands; monitoring; and a summary of the core topics and questions to be addressed in watershed analysis.

**Part 2** includes the detailed description of each of the six steps for conducting ecosystem analysis at the watershed scale. The six steps guide analysis teams through a series of questions to characterize the watershed, focus the analysis on essential issues, describe and understand current and historical conditions and processes, interpret the results, and develop recommendations for subsequent action by responsible officials.

Teams planning to conduct watershed analysis should first review both parts of this federal guide. The process is intended to be flexible and adaptable but still follow a consistent overall approach. Teams can be most efficient by developing an understanding of the entire six-step process, anticipating information and analysis needs, and planning for ways to synthesize the analysis at each step along the way.

## Future Additions to the Federal Guide

Section II of the Federal Guide will serve as a technical supplement or “tool box” of analytical methods and techniques designed to help address various aspects of watershed analysis and the Section I “core” topics. The goals of Section II are to meet Northwest Forest Plan goals, ensure scientific credibility, provide “methods and techniques,” and provide for cooperation and coordination with other watershed analysis processes.

---



## Summary of the Six-Step Process

The process for conducting ecosystem analysis at the watershed scale has six steps:

### 1. *Characterization of the watershed*

The purpose of step 1 is to identify the dominant physical, biological, and human processes or features of the watershed that affect ecosystem functions or conditions. The relationship between these ecosystem elements and those occurring in the river basin or province is established. When characterizing the watershed, teams identify the most important land allocations, plan objectives, and regulatory constraints that influence resource management in the watershed. The watershed context is used to identify the primary ecosystem elements needing more detailed analysis in subsequent steps.

### 2. *Identification of issues and key questions*

The purpose of step 2 is to focus the analysis on the key elements of the ecosystem that are most relevant to the management questions and objectives, human values, or resource conditions within the watershed. The applicability of the core questions and level of detail needed to address applicable core questions is determined. Rationale for determining that a core question is not applicable are documented. Additional topics and questions are identified based on issues relevant to the watershed. Key analysis questions are formulated from indicators commonly used to measure or interpret the key ecosystem elements.

### 3. *Description of current conditions*

The purpose of this step is to develop information (more detailed than the characterization in step 1) relevant to the issues and key questions identified in step 2. The current range, distribution, and condition of the relevant ecosystem elements are documented.

### 4. *Description of reference conditions*

The purpose of step 4 is to explain how ecological conditions have changed over time as a result of human influence and natural disturbances. A reference is developed for later comparison with current conditions over the period that the system evolved and with key management plan objectives.

### 5. *Synthesis and interpretation of information*

The purpose of step 5 is to compare existing and reference conditions of specific ecosystem elements and to explain significant differences, similarities, or trends and their causes. The capability of the system to achieve key management plan objectives is also evaluated.

### 6. *Recommendations*

The purpose of this step is to bring the results of the previous steps to conclusion, focusing on management recommendations that are responsive to watershed processes identified in the analysis. By documenting logical flow through the analysis, issues and key questions (from step 2) are linked with the step 5 synthesis and interpretation of ecosystem understandings (from steps 1, 3, and 4). Monitoring activities are identified that are responsive to the issues and key questions. Data gaps and limitations of the analysis are also documented.

For each of the six steps, Part 2 of this document generally describes the purpose of the step, core analysis topics and questions, summary or over-view questions, information sources, techniques that might prove helpful, products the analysis team would expect to generate in this step (but not necessarily include in the final document), and a general discussion of the step. The relative duration of each step is shown in figure 1.

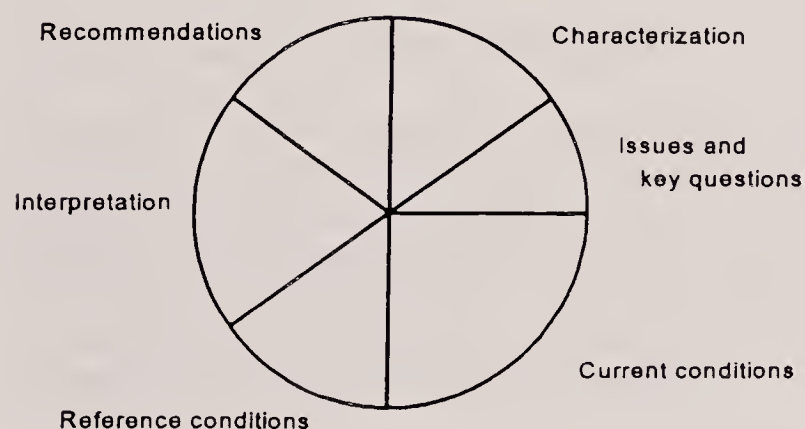


Figure 1. Relative duration of analysis steps.

## Process Considerations

### Participation in Watershed Analysis

#### *Use a Qualified Interagency and Interdisciplinary Team*

Teams conducting watershed analysis should include interagency and interdisciplinary resource specialists appropriate to the issues, ownerships, and respective jurisdictions within the watershed. Team members should be professionally qualified to assess and interpret the structure, composition, and functions of watershed-level ecosystems. Professional skills should



1. The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that this is crucial for ensuring the integrity of the financial data and for providing a clear audit trail.

2. The second part of the document outlines the specific procedures for recording transactions. It details the steps involved in entering data into the system, from initial entry to final verification.

3. The third part of the document describes the various controls and checks that are in place to prevent errors and fraud. It highlights the role of the internal audit function in monitoring these controls.

4. The fourth part of the document discusses the importance of regular reconciliation of the accounts. It explains how this process helps to identify discrepancies and ensure that the books are balanced.

5. The fifth part of the document provides a summary of the key points discussed and offers some final thoughts on the importance of good financial management.

6. The sixth part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that this is crucial for ensuring the integrity of the financial data and for providing a clear audit trail.

7. The seventh part of the document outlines the specific procedures for recording transactions. It details the steps involved in entering data into the system, from initial entry to final verification.

8. The eighth part of the document describes the various controls and checks that are in place to prevent errors and fraud. It highlights the role of the internal audit function in monitoring these controls.

9. The ninth part of the document discusses the importance of regular reconciliation of the accounts. It explains how this process helps to identify discrepancies and ensure that the books are balanced.

10. The tenth part of the document provides a summary of the key points discussed and offers some final thoughts on the importance of good financial management.

11. The eleventh part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that this is crucial for ensuring the integrity of the financial data and for providing a clear audit trail.

12. The twelfth part of the document outlines the specific procedures for recording transactions. It details the steps involved in entering data into the system, from initial entry to final verification.

13. The thirteenth part of the document describes the various controls and checks that are in place to prevent errors and fraud. It highlights the role of the internal audit function in monitoring these controls.

14. The fourteenth part of the document discusses the importance of regular reconciliation of the accounts. It explains how this process helps to identify discrepancies and ensure that the books are balanced.

15. The fifteenth part of the document provides a summary of the key points discussed and offers some final thoughts on the importance of good financial management.

16. The sixteenth part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that this is crucial for ensuring the integrity of the financial data and for providing a clear audit trail.

17. The seventeenth part of the document outlines the specific procedures for recording transactions. It details the steps involved in entering data into the system, from initial entry to final verification.

18. The eighteenth part of the document describes the various controls and checks that are in place to prevent errors and fraud. It highlights the role of the internal audit function in monitoring these controls.

19. The nineteenth part of the document discusses the importance of regular reconciliation of the accounts. It explains how this process helps to identify discrepancies and ensure that the books are balanced.

20. The twentieth part of the document provides a summary of the key points discussed and offers some final thoughts on the importance of good financial management.

21. The twenty-first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that this is crucial for ensuring the integrity of the financial data and for providing a clear audit trail.

22. The twenty-second part of the document outlines the specific procedures for recording transactions. It details the steps involved in entering data into the system, from initial entry to final verification.

23. The twenty-third part of the document describes the various controls and checks that are in place to prevent errors and fraud. It highlights the role of the internal audit function in monitoring these controls.

24. The twenty-fourth part of the document discusses the importance of regular reconciliation of the accounts. It explains how this process helps to identify discrepancies and ensure that the books are balanced.

25. The twenty-fifth part of the document provides a summary of the key points discussed and offers some final thoughts on the importance of good financial management.

26. The twenty-sixth part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that this is crucial for ensuring the integrity of the financial data and for providing a clear audit trail.

27. The twenty-seventh part of the document outlines the specific procedures for recording transactions. It details the steps involved in entering data into the system, from initial entry to final verification.

28. The twenty-eighth part of the document describes the various controls and checks that are in place to prevent errors and fraud. It highlights the role of the internal audit function in monitoring these controls.

29. The twenty-ninth part of the document discusses the importance of regular reconciliation of the accounts. It explains how this process helps to identify discrepancies and ensure that the books are balanced.

30. The thirtieth part of the document provides a summary of the key points discussed and offers some final thoughts on the importance of good financial management.

include those appropriate to analyze the core topics and other issues significant to the watershed. Involving other Federal agencies, especially early in the analysis, helps teams identify the full range of management issues and resource concerns in the watershed.

#### *Involve Tribes*

Tribes should be consulted and involved throughout the watershed analysis process, as appropriate, (1) to assist in the early identification of treaty rights, treaty protected resources, tribal trust resources, and other tribal concerns; and (2) to incorporate tribal data and resource knowledge into the analysis. Analysis reports should identify tribal trust resources that occur in the watershed and identify possible conflicts between potential Federal actions and management of the trust resources, treaty rights, tribal plans, and policies.

#### *Involve State and Local Government*

State and local governments play an essential role in determining ecosystem health at the watershed scale, both as land managers and regulators. State and local government participation will enable Federal land managers to consider all relevant issues in specific watershed analyses. Early and frequent interaction with state and local government partners also can help identify opportunities for cooperative efforts.

#### *Involve the Public*

Early, open, and frequent participation in the process by public stakeholders is encouraged. Public participants can provide important information about current and historical uses of the watershed, past disturbances, and location of unique and sensitive resources. Participation by public entities can help identify opportunities for public and private cooperation in watershed analysis, restoration, and other management activities. Among the many possible ways to involve publics are providing advanced notice of the intent to conduct an analysis, public meetings to solicit information useful in the analysis, providing opportunities for direct involvement in the analysis, and dissemination of analysis results.

### **Issues Define Scope and Priority of Analyses**

#### *Depth of Analysis*

Even though all watershed analyses will follow the structure outlined in this guide and address core topics, the scope, intensity, and depth of analyses will depend on the important management and resource issues in the watershed. "Issues" can be triggering events that prompted the agency to initiate the analysis. In this context, issues include management

programs, priorities, and potential projects; regulatory requirements; concerns people have about the watershed; or, other factors. Issues can also be resource problems or concerns in the watershed. In this context, issues include resource problems, concerns or other factors highlighted in the characterization of the watershed or in other steps.

This approach provides the flexibility for both triggering events and watershed specific resource problems and concerns to focus the analysis as appropriate. Responsible officials guiding the analysis will have to balance the number and scope of issues addressed in a given iteration of the analysis with available staffing and funding.

#### *Priority Setting*

The priorities for selecting watersheds to analyze reflect regional management priorities. Watersheds may be selected for analysis in response to anticipated resource and community needs, project opportunities, and existing issues that require immediate resolution.

### **Analysis Guides Project Development**

Although known program needs, issues, and opportunities may initially target watersheds for analysis, the analysis will influence the determination of appropriateness and resulting character of projects. New program planning and resource management projects should be developed in conjunction with and incorporate the results of watershed analysis.

### **Incorporate Analysis Information From Other Sources**

In most cases, analysis teams will have the benefit of other completed resource analyses. Forest-wide or District-wide analyses and plans, resource management plans, regional analyses, and species recovery plans will provide a wealth of information and analyses for the given watershed. Teams can interpret existing analyses as they relate to a particular watershed to speed their analyses without sacrificing scientific credibility. By incorporating the results of other analyses, teams may be able to reduce the size of their watershed reports. This method may not be appropriate for all resource issues, but teams should use the technique wherever possible to increase efficiency of team efforts.

### **Incremental Approach**

Federal agencies will conduct multiple analysis iterations of watersheds as new information becomes

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that this is crucial for ensuring the integrity of the financial system and for providing a clear audit trail.

2. The second part of the document outlines the various methods used to collect and analyze data. It describes how different types of information are gathered and how they are processed to identify trends and patterns.

3. The third part of the document focuses on the results of the analysis. It presents the findings of the study and discusses the implications of these results for the future of the industry.

4. The fourth part of the document provides a summary of the key points discussed in the previous sections. It highlights the main conclusions and offers recommendations for further research.

5. The fifth part of the document contains a list of references to the sources used in the study. This includes books, articles, and other documents that provide additional context and support for the findings.

6. The sixth part of the document is a conclusion. It summarizes the overall findings of the study and offers a final thought on the importance of the research.

7. The seventh part of the document is a list of appendices. These include additional data, charts, and other information that is relevant to the study but is too detailed to include in the main text.

8. The eighth part of the document is a list of footnotes. These provide additional information about the sources and the methods used in the study.

9. The ninth part of the document is a list of figures. These are visual representations of the data, such as graphs and charts, that help to illustrate the findings of the study.

10. The tenth part of the document is a list of tables. These are organized collections of data that provide a detailed view of the information used in the study.

11. The eleventh part of the document is a list of abbreviations. These are short forms of words or phrases that are used throughout the document to save space and avoid repetition.

12. The twelfth part of the document is a list of definitions. These are explanations of the terms and concepts used in the study, ensuring that everyone reading the document has a clear understanding of what is being discussed.

13. The thirteenth part of the document is a list of acknowledgments. These are statements of appreciation for the people and organizations that have helped to make the study possible.

14. The fourteenth part of the document is a list of references. These are citations of the sources used in the study, providing a way for readers to find the original information if they wish.

15. The fifteenth part of the document is a list of footnotes. These are additional notes that provide more detail about the sources and the methods used in the study.

16. The sixteenth part of the document is a list of appendices. These are additional data, charts, and other information that is relevant to the study but is too detailed to include in the main text.



available, or as ecological conditions, management needs, or social issues change. The time between iterations will depend on factors such as major disturbance events, monitoring or research results, new management objectives, and different regulatory requirements. Subsequent analysis iterations may be triggered when existing analyses do not adequately support informed decisionmaking for particular issues or projects. Future iterations also may be necessary to fill critical data gaps identified during earlier analyses. As subsequent analyses are conducted, new information will be added to that created in previous analyses.

## Accountability

### *Peer Review*

Watershed analysis teams are encouraged to review each others' approaches and reports. Agencies or administrative units should establish peer review procedures to evaluate all or a sample of watershed analyses conducted within their jurisdiction. The Research and Monitoring Committee, with concurrence by the Intergovernmental Advisory Committee, will develop a scientific peer review process to evaluate the scientific credibility and adequacy of watershed analyses. Such reviews could provide important feedback on whether analyses were based on sound scientific information, provided useful recommendations to managers, and met the requirements of existing plans and direction.

### *Responsible Official*

The success of a watershed analysis will depend on how useful it is to decision makers and resource specialists applying the results. The ultimate adequacy of the analysis will, in large part, lie in the responsible official's ability to understand and apply the results to document a consistency of logic in reaching subsequent management decisions that meet the objectives of the Northwest Forest Plan (NFP) and other relevant land use plans.

## Technical Considerations

### Watershed Scales and Hierarchy

#### *Definition of "Watershed"*

"Watershed" refers to any area of land that drains to a common point. Unfortunately, the size of the area that one person associates with "watershed" may be quite a bit larger or smaller than the area another person has in mind when they say "watershed." To some, a watershed may be as large as the area that drains to the Columbia River. To others, it may be much smaller--maybe the area above a favorite fishing hole

or hot springs. Both are technically correct. Before analysis at the watershed scale can begin, a consistent vision of the size of the area involved is needed.

Watersheds are hierarchical--little ones nest within larger ones. A set of commonly used terms that describe relative sizes of geographic areas is shown below and in figure 2. "Watershed" refers to one level in the progression of geographic sizes. A watershed is smaller than a river basin or subbasin, but it is larger than a drainage or site.

<u>Hierarchy terms</u>	<u>Examples</u>
Region	Pacific Northwest
Subregion	Middle Columbia
River Basin	Willamette River
Subbasin	Middle Fork Willamette
Watershed	M.F. Willamette downstream tributaries
Subwatershed	Hills Creek
Drainage	Packard Creek arm
Site	Hills Creek Dam

Because watersheds are hierarchical, smaller areas are described by subdividing larger areas. The U.S. Geological Survey completed mapping of the first four hierarchical levels of the United States in 1987. Across the United States, subdivision of fourth-level subbasins has been sporadically approached based on agency needs and available resources.

Watershed is a useful term to associate with all areas resulting from the first subdivision of a subbasin. The watershed, then, is the fifth largest level in the hierarchy and is often referred to as a "fifth-field watershed." With the increased emphasis on ecosystem-based management, the development of criteria for delineating the watershed and subwatershed levels is being given greater priority by Federal, state, local, and tribal governments.

The procedure for subdividing a subbasin into a collection of watersheds is highly debated. Regardless of the process used, subdivision of a subbasin yields two categories of watersheds: (1) true watersheds in which all water flows to a common point (figure 3, areas 1-7), and (2) areas formed as residuals or byproducts of delineating true watersheds (figure 3, areas 8 and 9). These residual areas may be referred to as composite watersheds, interfluvial areas, or facial areas. Both categories, being roughly the same size, fit within the watershed level of the geographic size hierarchy.



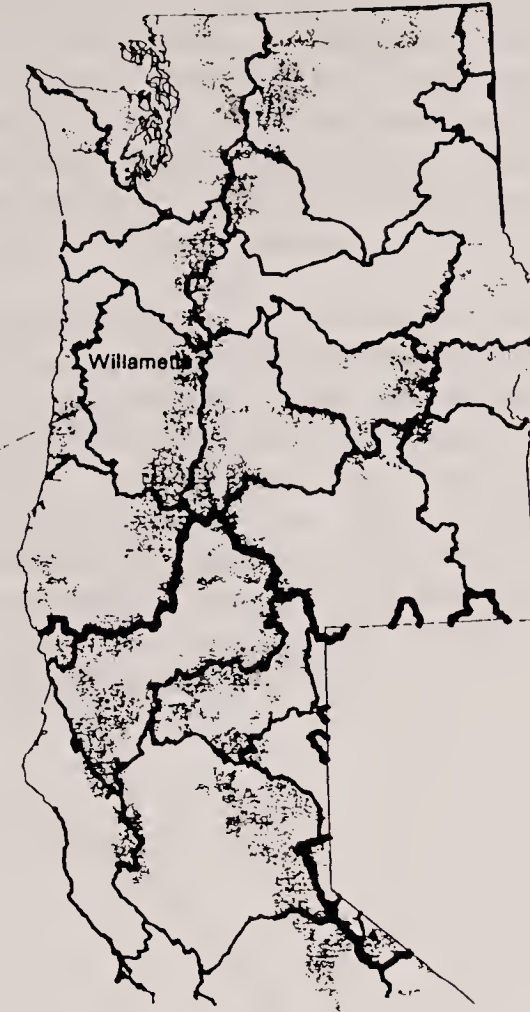
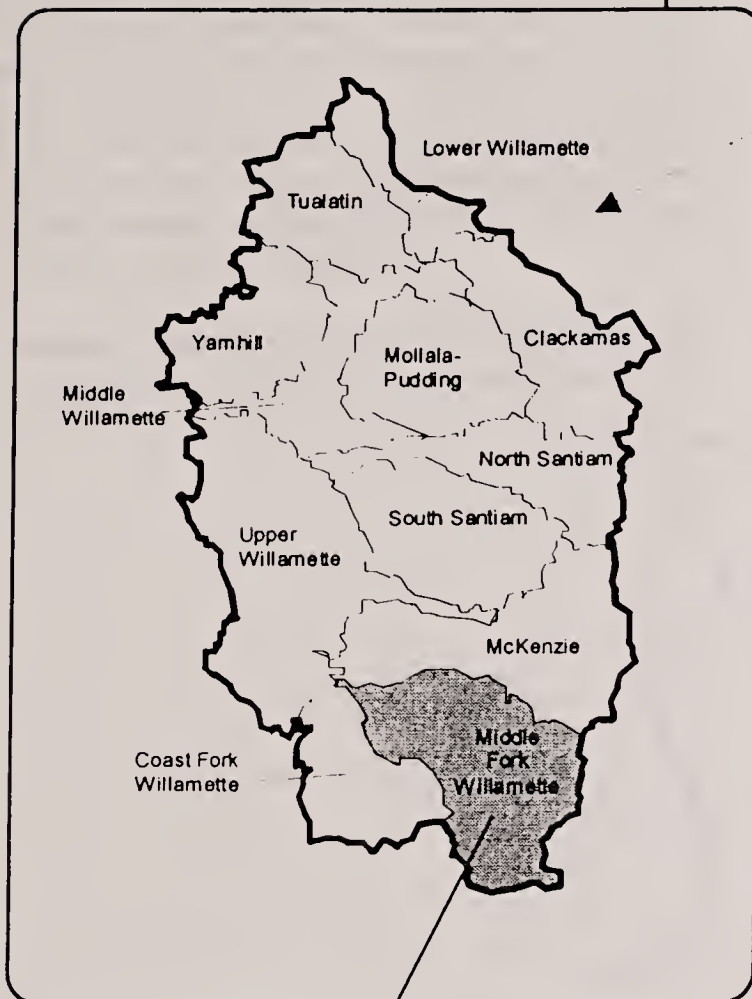


## River Basins

(USGS 3rd field)

## Subbasins

(USGS 4th field)



## Subwatershed, Drainage, Site

Hills Creek  
Dam Site

Packard Cr. arm  
Drainage

Hills Cr.  
Subwatershed



## Watersheds

5th field

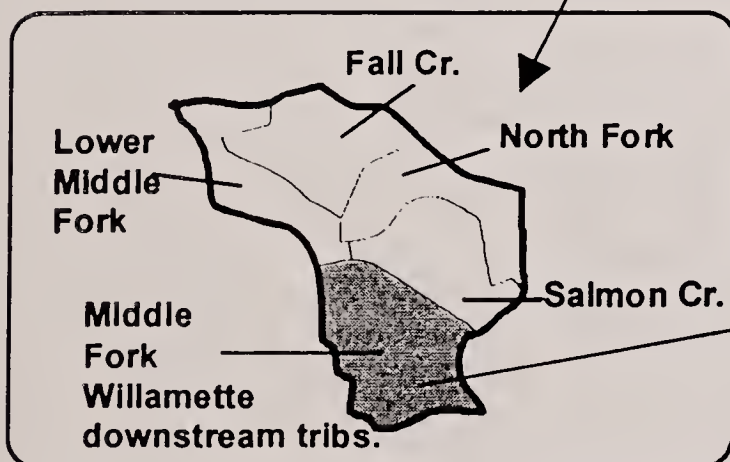


Figure 2. Hierarchy of watersheds.





### *Scales of Analysis*

Any size land area can be selected for analysis. At the broadest scales, analyses provide the context for policy formulation and laws; e.g., regional-scale analyses from the Forest Ecosystem Management Assessment Team (FEMAT 1993) report resulted in a network of Late Successional Reserves (LSR) and other policies of the NFP. At finer scales, analyses provide the context for projects and are used to evaluate site-specific impacts or effects. Midscale analyses, at the watershed scale, provide the context for management through the description and understanding of specific ecosystem conditions and capabilities. Midscale analysis does not work well for all ecosystem components. Some components of ecosystems are best analyzed at larger scales (e.g., wildlife or fish populations, social interactions). Broad pattern recognition, process identification, and priorities for subsequent analysis over extended periods can be effectively completed at the river basin or subbasin scale.

Other ecosystem components may be analyzed best at smaller scales (e.g., some rare, threatened, or

endangered plants). Analyses done at the drainage or site scale tend to be highly quantitative and appropriate for shorter time scales. Those issues possibly requiring areas smaller than the watershed for analysis can be addressed by further stratifying the land during analysis. There may be good reasons to resort to a subwatershed scale for some analyses. Analyses at the subwatershed level will tend to be more targeted at determination of potential effects of management activities rather than processes or functions of ecosystems.

Characterization and analysis of any ecosystem component need to be done at the scale appropriate for that component. The watershed becomes an identifiable analysis unit useful for reporting the results, conclusions, and recommendations in sufficient detail to provide the context for management decisions. Regardless of the physical area selected, one analysis will draw context from larger-scale analyses and provide the context for analyses at smaller scales.

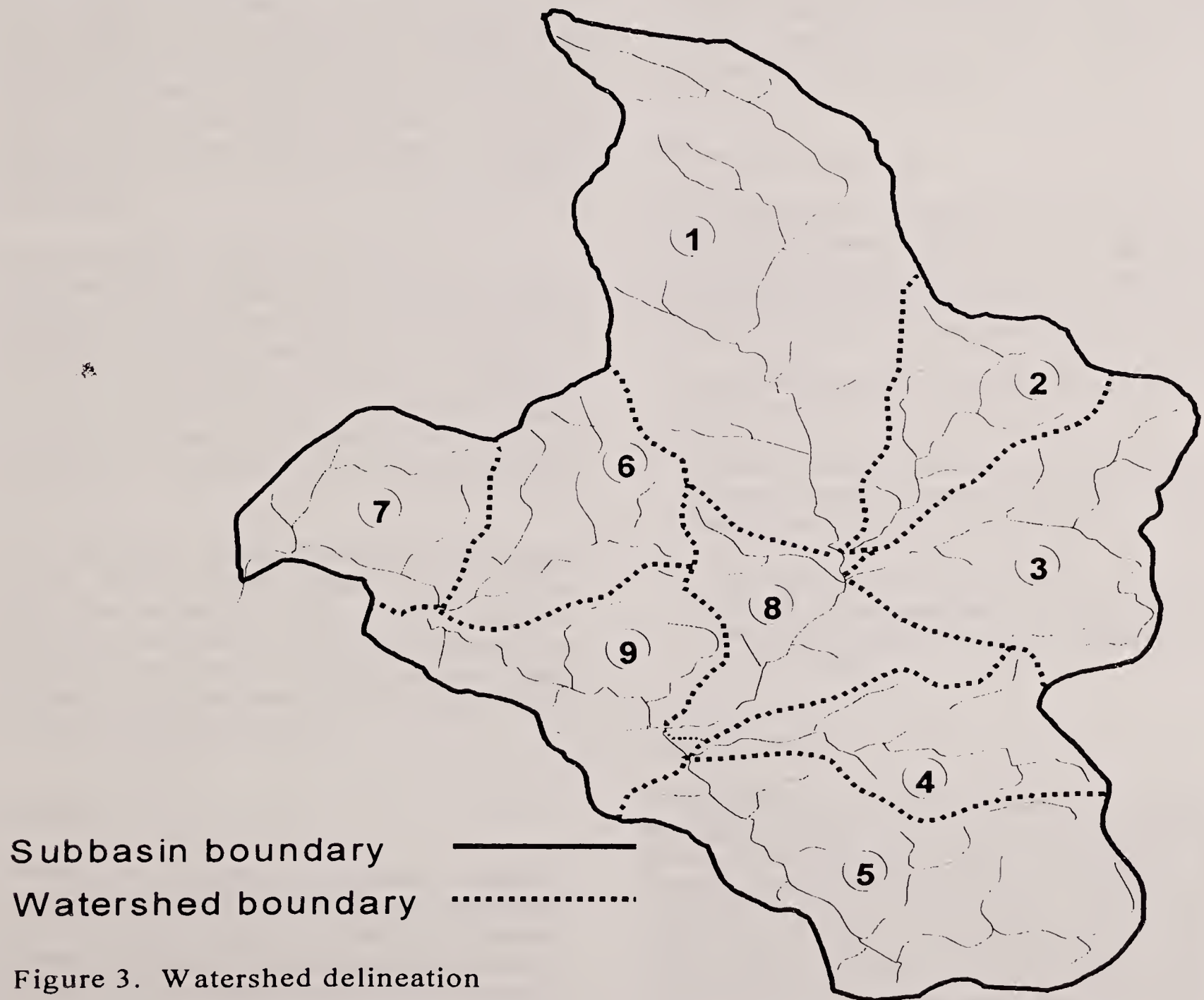


Figure 3. Watershed delineation

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that this is crucial for the company's financial health and for providing reliable information to stakeholders.

2. The second part of the document outlines the procedures for handling customer inquiries. It states that all inquiries should be handled promptly and professionally, and that the company should strive to provide excellent customer service at all times.

3. The third part of the document discusses the company's commitment to environmental sustainability. It states that the company will continue to implement measures to reduce its carbon footprint and to promote sustainable practices throughout its operations.

4. The fourth part of the document discusses the company's commitment to social responsibility. It states that the company will continue to support various community programs and initiatives, and that it will strive to be a good corporate citizen in all respects.

5. The fifth part of the document discusses the company's commitment to employee development. It states that the company will continue to invest in its employees, providing them with training and development opportunities to help them grow and advance in their careers.

6. The sixth part of the document discusses the company's commitment to innovation. It states that the company will continue to invest in research and development, and that it will strive to develop new products and services that meet the needs of its customers.





The size of the area chosen for analysis depends on the purpose of the analysis, the topics to be analyzed, and the physical, biological, and social complexity of the area. With watershed analysis, the challenge is to select an area such that the data and information are useful for deciding what management activities are compatible with ecosystem goals--not so broad that conclusions are not directly helpful to managers and not so refined or detailed that the information does not show broader ecosystem needs. The watershed provides an intermediate scale that satisfies many needs and offers a consistent format for reporting results of an analysis.

The analysis process described in this guide is designed for application at the watershed or subwatershed level. The guide does not address procedures for drainage or site-specific assessments that may be required under NEPA processes before project implementation. Similarly, the guide does not address consolidation of watershed analyses to assist in broad pattern recognition or process identification at the river basin or subbasin scales. Assessments of these larger scales are provided, for example, in the "Effectiveness Monitoring" section of the ROD (E-7). Specific methods for evaluating the success of the NFP in meeting the goals of biodiversity and late successional old-growth ecosystems are under development by the Research and Monitoring Committee.

#### *Scale, Resolution, Utility, and Efficiency*

Watershed-scale analysis guides site-level project planning and decisionmaking by providing the watershed context. As watershed size increases, it becomes more difficult to provide meaningful information for this use. As watershed size decreases, the larger scale context may be lost, and the analysis may begin to duplicate site-level or project-level assessments.

When planning a watershed analysis, teams should consider the size of the watershed relative to data needs, data availability, resolution, and time and resource requirements, as well as the issues to be addressed. Teams generally should avoid analyzing watersheds significantly smaller than 20 square miles or larger than 200 square miles.

## **Synthesis**

Synthesis, the integration of separate ecosystem elements to understand the whole system, is a primary goal of watershed analysis. Teams can promote synthesis by looking for connections and relations between the major ecological features and processes in the watershed. For example, stream channel

classification may be needed to understand fisheries use, and also to understand sediment transport processes and how they influence fish habitat. Synthesis depends heavily on close interdisciplinary work.

By developing the ability to integrate and synthesize the understanding of individuals and disciplines, teams can increase the scientific credibility and management utility of analysis results. Team understanding of the systems being analyzed allows more definite and accurate interpretations of conditions, causes, and trends. Team discussions early in the process (starting with step 1) can lead to a much clearer understanding of the processes and linkages between resources.

Data may be assembled, collected, or interpreted to serve a variety of purposes. As the team assembles information, it should anticipate the eventual uses of the data and analyses. Identifying common data and analysis needs early in the process and agreeing to common methods, to the extent possible, will contribute greatly to synthesis.

## **Tiered Key Questions**

By developing tiers of hierarchical questions, teams can promote synthesis and develop consistent logic through the analysis. Broad questions addressing connections and relations can be progressively refined into more detailed or focused questions. For example:

What human elements influence the condition of aquatic and terrestrial ecosystem elements?

How have human activities changed the landscape pattern of plant communities from the range of natural conditions in the watershed?

How have these changes in landscape patterns affected erosion processes, hydrology, channel form, water quality, distribution of species, and habitat quality?

## **Logic Tracking**

A major objective for analysis reports is documenting the logic followed in the analysis process from planning the analysis through development of recommendations. Logic tracking is essential for the credibility and utility of the analysis. Because the results of each step can contribute greatly to the content of the final report, team members should also clearly document the work done in each progressive step.

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that this is crucial for ensuring the integrity of the financial system and for providing a clear audit trail.

2. The second part of the document outlines the specific procedures for recording transactions. It details the steps involved in entering data into the system, from initial entry to final verification.

3. The third part of the document addresses the issue of data security. It discusses the various measures that should be taken to protect sensitive information from unauthorized access and loss.

4. The fourth part of the document discusses the importance of regular backups. It explains how backups can help prevent data loss in the event of a system failure or disaster.

5. The fifth part of the document outlines the procedures for handling errors. It provides guidance on how to identify and correct mistakes, as well as how to prevent them from occurring in the future.

6. The sixth part of the document discusses the importance of training. It emphasizes that all users should receive proper training on how to use the system correctly.

7. The seventh part of the document discusses the importance of documentation. It explains how documentation can help ensure that the system is used consistently and that all users are aware of the correct procedures.

8. The eighth part of the document discusses the importance of communication. It emphasizes that all users should be kept informed of any changes to the system or procedures.

9. The ninth part of the document discusses the importance of monitoring. It explains how monitoring can help identify potential problems before they become major issues.

10. The tenth part of the document discusses the importance of evaluation. It explains how regular evaluations can help ensure that the system is meeting its intended purpose and that any necessary improvements are made.

11. The eleventh part of the document discusses the importance of compliance. It explains how the system should be designed to meet all relevant regulatory requirements.

12. The twelfth part of the document discusses the importance of user feedback. It explains how user input can be used to improve the system and make it more user-friendly.

13. The thirteenth part of the document discusses the importance of disaster recovery. It explains how a disaster recovery plan should be developed and tested to ensure that the system can be restored in the event of a disaster.

14. The fourteenth part of the document discusses the importance of security. It explains how security measures should be implemented to protect the system from threats.

15. The fifteenth part of the document discusses the importance of performance. It explains how performance metrics should be monitored to ensure that the system is running efficiently.

16. The sixteenth part of the document discusses the importance of scalability. It explains how the system should be designed to handle increasing amounts of data and users.

17. The seventeenth part of the document discusses the importance of flexibility. It explains how the system should be designed to adapt to changing requirements.

18. The eighteenth part of the document discusses the importance of reliability. It explains how the system should be designed to be available and reliable at all times.

19. The nineteenth part of the document discusses the importance of security. It explains how security measures should be implemented to protect the system from threats.

20. The twentieth part of the document discusses the importance of user feedback. It explains how user input can be used to improve the system and make it more user-friendly.

21. The twenty-first part of the document discusses the importance of disaster recovery. It explains how a disaster recovery plan should be developed and tested to ensure that the system can be restored in the event of a disaster.

22. The twenty-second part of the document discusses the importance of security. It explains how security measures should be implemented to protect the system from threats.

23. The twenty-third part of the document discusses the importance of performance. It explains how performance metrics should be monitored to ensure that the system is running efficiently.

24. The twenty-fourth part of the document discusses the importance of scalability. It explains how the system should be designed to handle increasing amounts of data and users.

25. The twenty-fifth part of the document discusses the importance of flexibility. It explains how the system should be designed to adapt to changing requirements.

26. The twenty-sixth part of the document discusses the importance of reliability. It explains how the system should be designed to be available and reliable at all times.

27. The twenty-seventh part of the document discusses the importance of security. It explains how security measures should be implemented to protect the system from threats.

28. The twenty-eighth part of the document discusses the importance of user feedback. It explains how user input can be used to improve the system and make it more user-friendly.

29. The twenty-ninth part of the document discusses the importance of disaster recovery. It explains how a disaster recovery plan should be developed and tested to ensure that the system can be restored in the event of a disaster.

30. The thirtieth part of the document discusses the importance of security. It explains how security measures should be implemented to protect the system from threats.



## Iterative Analysis Steps

Teams should generally conduct the six analysis steps in sequence. In some cases, information and understanding developed in one step may result in cycling back to previous steps to further refine the process or products, or both.

## Data Gaps, Assumptions, and Level of Confidence

Teams may discover they lack, and cannot acquire, essential information about ecological processes and conditions in the watershed. When this happens, teams should describe in their report:

- Missing data needs
- Implications of data deficiencies and risks of proceeding given the quality of currently available data
- Recommendations for prioritizing data collection
- Assumptions used in the absence of data

This description is important to relate the level of confidence a team will have in their recommendations to the responsible official.

Possible strategies for addressing data gaps include:

- Attain complete data coverage of an area at a lower level of resolution than is ordinarily desired
- Attain complete data coverage of an area for a subset of the usual attributes
- Extrapolate data from representative subareas or substrata
- Stop analysis and collect data

## Relation to Other Laws, Regulations, Processes, and Lands

### Federal Laws and Regulation

Watershed analysis provides understanding of the watershed context that is essential to guide project planning and decisionmaking. Watershed analysis is not a decisionmaking process, and a watershed analysis report is not a decision document, a planning document requiring NEPA review, or a regulatory, prescriptive document. Watershed analysis contributes, however, to efficiently meeting land management and regulatory requirements at the watershed scale as the following examples show.

*National Forest Management Act (NFMA), Federal Land Policy and Management Act (FLPMA), Oregon and California Lands Act (O&C Act)*

Results from watershed analyses can assist in the development of ecologically sustainable commodity production programs (e.g., water, timber, recreation) by defining the context necessary to protect ecosystem functions. Analyses also can aid planning by stratifying areas of the watershed by inherent capability, sensitivity to disturbance, and suitability to sustain public use. Information should be presented in a manner that facilitates the location and timing of compatible projects; interpretation of applicable standards and guidelines with existing and possible future conditions; and assessments of habitat and population viability trends. The results of watershed analyses can facilitate program and budget development by identifying and setting priorities for social, economic, and ecological needs and capabilities within and among watersheds. Analyses also can assist in establishing a context for identifying and prioritizing watershed restoration needs. Analyses can support planning processes, including plan amendments if conflicts between plan features and ecosystem capabilities and protection needs are identified.

*National Environmental Policy Act (NEPA)*

Results of watershed analyses establish a consistent, watershed-wide context for project-level NEPA documents. Information from analyses should be used to enhance the quality of project or action-specific NEPA documents. Watershed analyses can form a strong basis for NEPA cumulative effects analysis by describing the current environment at the watershed level, past and present management activities and their influences on the watershed, and the likely historical conditions. In turn, project-level NEPA documents should augment watershed analyses with site-specific data and analyses. In reaching subsequent decisions through the NEPA process, responsible officials should document a consistency of logic with watershed analysis results.

*Endangered Species Act (ESA)*

Results of watershed analyses establish a consistent, watershed-wide context for Section 7 conferencing and consulting pursuant to the ESA. Analysis reports include information applicable to many projects and activities. Information on existing population status, species distribution, and habitat conditions presented in analyses can subsequently be used to evaluate the effects of proposed actions, assist in determining measures to avoid jeopardy and adverse modification of critical habitat, and reverse declining habitat and population trends. Information should be presented in





a manner that enables project-level consultation documents to directly reference or incorporate pertinent sections of analysis reports. Watershed analyses may also contribute information to support Section 4 and 7 (listing, recovery, and consultation) and Section 10 (permits and habitat conservation planning) activities.

#### *Clean Water Act (CWA)*

Results of watershed analyses establish a consistent watershed-wide context for water quality efforts by local governments and for protection of beneficial uses identified by the states and tribes in their water quality standards under the Federal Clean Water Act. Results of watershed analyses may subsequently be used to develop or update state, local, or tribal water quality management plans. Watershed analysis establishes a context for identifying resource protection and monitoring needs and restoration opportunities that are responsive to water quality issues described in the analysis.

#### *Federal Trust Responsibilities to Indian Tribes*

Watershed analyses establish the watershed context for early identification of treaty rights, treaty protected resources, and other tribal concerns. The results of watershed analyses will assist the Bureau of Land Management (BLM) and Forest Service (FS) in complying with policies and laws relating to tribal trust resources. Analysis reports should identify tribal trust resources that occur in the watershed and identify possible conflicts between potential Federal actions and management of the trust resources, treaty rights, tribal plans, and policies. Subsequent decisions concerning identified conflicts will be reached outside the watershed analysis framework, in ways consistent with the Federal government's trust responsibilities.

### **Other Analysis Processes and Plans**

There are a variety of other analysis processes that are relevant at the watershed scale. Some examples are described below. Federal analysis teams should contact state, local, and tribal governments to determine if other analyses have been completed, are underway, or are planned in, or adjacent to, watersheds proposed for Federal analysis. Federal analysis teams should strive to conduct analyses in a manner consistent with this federal guide, but compatible with other relevant analysis processes. Teams should take advantage of opportunities for coordinated and cooperative analysis efforts, including data sharing, developing common data sets, agreeing to common analysis methods (modules), and defining compatible analysis boundaries.

#### *State Water Quality Management Plans*

Each state has the authority and responsibility to certify that Federal land management agency programs will meet water quality standards. Watershed analysis can be used to provide a basis for management prescriptions in both project and planning decisions. Where watershed analysis is being used to address Clean Water Act issues on both Federal and non-Federal land, there should be comparability and compatibility between analyses that cross geographic or jurisdictional boundaries.

#### *Washington State Analysis Process*

The Washington State watershed analysis process, developed by the Washington Forest Practices Board, is a principal tool for addressing cumulative effects of forest management on stream conditions. The Washington method includes modules for assessing elements of the watershed and synthesizing this information. While Washington modules describe a minimum protocol for conducting the analysis, the process allows for modifying the modules if the analysis team wishes to use equal or better methods. The analysis process results in a set of prescriptions for the watershed that are subjected to State review, then adopted as requirements for future forest management in that watershed.

Washington has delineated watershed analysis units that predefine the geographic scope of analyses conducted under state regulation. These watershed analysis units have been prioritized based on criteria reflecting need for cumulative effects analysis when conducted by the State. Analyses may be initiated by the Department of Natural Resources or by landowners within the watershed.

#### *Local Watershed Efforts*

Analyses at the watershed scale may be ongoing, planned, or have been completed by local watershed councils, model watershed groups, bioregional councils, conservation districts, or other local action groups. Analyses by these groups in cooperation with Natural Resources Conservation Service and other agencies may include inventory and assessment phases of watershed health activities, watershed planning, river basin studies, and Coordinated Resource Management Planning (CRMP). These volunteer private landowner processes may be relevant within a given watershed. Teams should identify and pursue opportunities for coordinated and cooperative analyses with these local efforts.

#### *Habitat Conservation Plans on Non-Federal Lands*

Both Federal and state watershed analyses offer interdisciplinary and cooperative processes that can provide information and establish a watershed-scale

1. The first part of the report deals with the general situation of the country. It is a very interesting and informative study of the country's development. The author has done a great deal of research and has gathered a wealth of material. The report is well written and is easy to read. It is a valuable contribution to the study of the country's development.

2. The second part of the report deals with the economic situation of the country. It is a very interesting and informative study of the country's economic development. The author has done a great deal of research and has gathered a wealth of material. The report is well written and is easy to read. It is a valuable contribution to the study of the country's economic development.

3. The third part of the report deals with the social situation of the country. It is a very interesting and informative study of the country's social development. The author has done a great deal of research and has gathered a wealth of material. The report is well written and is easy to read. It is a valuable contribution to the study of the country's social development.

4. The fourth part of the report deals with the political situation of the country. It is a very interesting and informative study of the country's political development. The author has done a great deal of research and has gathered a wealth of material. The report is well written and is easy to read. It is a valuable contribution to the study of the country's political development.

5. The fifth part of the report deals with the cultural situation of the country. It is a very interesting and informative study of the country's cultural development. The author has done a great deal of research and has gathered a wealth of material. The report is well written and is easy to read. It is a valuable contribution to the study of the country's cultural development.

6. The sixth part of the report deals with the environmental situation of the country. It is a very interesting and informative study of the country's environmental development. The author has done a great deal of research and has gathered a wealth of material. The report is well written and is easy to read. It is a valuable contribution to the study of the country's environmental development.

7. The seventh part of the report deals with the international situation of the country. It is a very interesting and informative study of the country's international development. The author has done a great deal of research and has gathered a wealth of material. The report is well written and is easy to read. It is a valuable contribution to the study of the country's international development.

8. The eighth part of the report deals with the future of the country. It is a very interesting and informative study of the country's future development. The author has done a great deal of research and has gathered a wealth of material. The report is well written and is easy to read. It is a valuable contribution to the study of the country's future development.

9. The ninth part of the report deals with the conclusion of the study. It is a very interesting and informative study of the country's development. The author has done a great deal of research and has gathered a wealth of material. The report is well written and is easy to read. It is a valuable contribution to the study of the country's development.



context for habitat conservation plans developed for private lands under Section 10 of the Endangered Species Act.

### **Federal Watershed Analysis and Non-Federal Lands**

Even though the Federal watershed analysis process is in no way intended to regulate non-Federal lands, analysis teams, as guided by responsible officials, will consider the interactions of various land ownerships in the watershed. Federal land management decisions based on the results of watershed analysis need to consider conditions and activities on adjacent non-Federal lands, especially to evaluate cumulative effects, as they affect public lands, pursuant to NFMA, NEPA, ESA, CWA, O&C Act, and other pertinent statutes. Consideration of these interactions is important to an overall understanding of ecological functions and processes.

Cooperative approaches to watershed analyses that cross jurisdictional and ownership boundaries are encouraged. Analysis teams, as guided by responsible officials, are encouraged to contact non-Federal landowners in the watershed and to foster voluntary participation in all stages of the analysis. Voluntary participation by non-Federal landowners will enhance each team's ability to share data and better understand the interactions of various land ownerships in the watershed. Teams should recognize that even with voluntary landowner participation, there may be concerns regarding proprietary data and public access to sensitive information.

In those instances where landowners do not voluntarily choose to participate, publicly available information should be used in the analysis. Publicly available information about topography, soils, geology, hydrology, transportation systems, and vegetation may be available, for example, through aerial photos, or state and local government records. Although this type of information will usually be available at a coarser level of resolution than information obtained through cooperative land-owner participation, it may be acceptable for developing a general understanding of the conditions and processes interacting with adjacent Federal lands.

### **Monitoring**

Information from watershed analysis can be used to develop monitoring strategies and objectives for the watershed. Analyses provide information about

patterns and processes within watersheds that can be used to:

- Reveal the most useful indicators for monitoring environmental change
- Detect magnitude and duration of changes in conditions
- Formulate and test hypotheses about the causes of the changes
- Understand these causes and predict impacts
- Manage the ecosystem for desired outcomes

Watershed analysis results assist in developing monitoring plans by revealing the most useful indicators for monitoring environmental changes within each watershed. Characteristics of good monitoring indicators, in addition to those described by MacDonald et al. (1991), include those that

- Are sensitive and responsive to management actions
- Have low spatial and temporal variability
- Are easy to measure (accurate and precise)
- Relate directly to beneficial uses of the watershed
- Are early warning indicators
- Represent broader or more complex ecological processes or subsystem

When making recommendations for monitoring, teams should consider both the monitoring needs of the watershed and the role of the watershed in existing Forest, District, regional or other broader scale monitoring plans. Monitoring plans developed at broader scales may require sample points within the watershed. Results of watershed analyses provide information for determining where such monitoring points should be located.

### **Core Topics**

Every watershed analysis will be different, depending on the reasons for conducting the analysis and the resource concerns unique to the watershed, even though a common approach based on the six analysis steps will be followed. All watershed analyses should address the basic ecological conditions, processes, and interactions (elements) at work in the watershed. The following core topics are intended to provide the framework for focusing the basic analysis within the watershed. The appropriate level of detail needed to address each of the core topics should be determined by the responsible official, based on recommendations by the team and with consideration of the issues relevant to the analysis (triggering events or resource concerns).

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that proper record-keeping is essential for the integrity of the financial system and for the ability to detect and prevent fraud. The text also mentions the need for regular audits and the role of independent auditors in ensuring the reliability of the data.

2. The second part of the document focuses on the challenges faced by organizations in implementing effective internal controls. It highlights the complexity of modern business environments and the need for a robust framework of controls to manage risks. The text suggests that organizations should adopt a risk-based approach to internal control design and implementation, focusing on the most significant risks to the organization's objectives.

3. The third part of the document discusses the importance of transparency and accountability in financial reporting. It notes that stakeholders, including investors, creditors, and the public, rely on the information provided in financial statements to make informed decisions. The text stresses the need for organizations to provide clear, concise, and reliable information, and to be held accountable for the accuracy of their reports.

4. The fourth part of the document addresses the issue of financial stability and the role of regulatory bodies in maintaining it. It discusses the potential risks to financial stability arising from systemic risks and the need for regulatory intervention to mitigate these risks. The text also mentions the importance of international cooperation in addressing global financial challenges and the role of international organizations in setting standards and promoting best practices.

5. The fifth part of the document discusses the importance of financial literacy and the role of education in promoting it. It notes that financial literacy is a key skill for individuals to make sound financial decisions and to participate effectively in the economy. The text suggests that governments and educational institutions should work together to provide financial education to the public, particularly to young people, to ensure that they have the knowledge and skills needed to manage their finances responsibly.

6. The sixth part of the document discusses the importance of financial innovation and the role of technology in driving it. It notes that financial innovation has the potential to improve the efficiency and effectiveness of financial systems and to create new opportunities for growth and development. The text also mentions the risks associated with financial innovation, such as the potential for increased complexity and the emergence of new risks, and the need for regulatory oversight to ensure that innovation is managed responsibly.

7. The seventh part of the document discusses the importance of financial inclusion and the role of policy in promoting it. It notes that financial inclusion is a key goal of many governments and international organizations, as it can help to reduce poverty and improve the living standards of low-income populations. The text suggests that governments should implement policies that encourage financial inclusion, such as providing access to basic financial services and promoting the development of microfinance institutions.

8. The eighth part of the document discusses the importance of financial sustainability and the role of responsible investment in promoting it. It notes that financial sustainability is a key concern for investors and other stakeholders, as it ensures that organizations can generate long-term value and maintain their ability to pay dividends and meet their obligations. The text suggests that investors should consider environmental, social, and governance (ESG) factors when making investment decisions, and that organizations should adopt responsible investment practices to ensure their long-term sustainability.

9. The ninth part of the document discusses the importance of financial resilience and the role of risk management in promoting it. It notes that financial resilience is the ability of an organization to withstand and recover from adverse events, such as financial crises or natural disasters. The text suggests that organizations should implement robust risk management frameworks to identify, assess, and mitigate risks, and that they should have contingency plans in place to ensure their ability to continue operating in the event of a crisis.

10. The tenth part of the document discusses the importance of financial integrity and the role of ethics in promoting it. It notes that financial integrity is a fundamental principle of the financial system, and that it is essential for the system to function effectively and to maintain the trust of its participants. The text suggests that organizations should adopt a strong ethical culture and implement measures to ensure that all transactions are conducted in a fair and transparent manner, and that they are free from corruption and other unethical practices.



The core topics represent the major and common ecological elements, and their relationships, in all watersheds. The topics are purposely broad and general, as they encourage a watershed-level perspective of the system as opposed to a site or project-level perspective. The purpose of the core topics is to ensure that responsible officials and their teams adequately address the major elements and their relationships in the watershed. The core analysis topics help ensure that analyses are sufficiently comprehensive to develop a basic understanding of the watershed. The analysis team should demonstrate understanding and knowledge of the basic ecological conditions, processes, and interactions in the watershed by addressing the following core topics through the six-step process:

- Erosion processes
- Hydrology
- Vegetation
- Stream channel
- Water quality
- Species and habitats
- Human uses

## Core Questions

Core questions are designed to guide teams through the six-step process. The core questions are intended to focus the team's thinking on the core topics, not to set a minimum level of analysis needed to address each core topic. They are designed to help teams show a basic level of knowledge regarding the watershed through documentation of the findings and logic trail. The level of detail may range from professional knowledge and judgment to in-depth analysis, depending on the issues relevant to the analysis. The rationale for determining that a core question is not applicable will be documented.

The core questions are intended to be general in nature to allow the watershed team flexibility in determining the appropriate level of analysis, as judged by the responsible official, for each core topic. The analytical progression of the core questions for each topic generally parallels the analysis steps, with the first questions aimed at characterization and the last questions addressing integration and interpretation. Teams can apply this pattern of questions to other topics identified for analysis in a particular watershed. The following core questions are listed by core topic. These questions are repeated in Part 2 under the detailed descriptions of pertinent process steps.

## Erosion Processes

- Step 1: What erosion processes are dominant within the watershed (e.g., surface erosion processes, mass wasting)? Where have they occurred or are they likely to occur?
- Step 2: Core questions not addressed.
- Step 3: What are the current conditions and trends of the dominant erosion processes prevalent in the watershed?
- Step 4: What are the historical erosion processes within the watershed (e.g., surface erosion processes, mass wasting)? Where have they occurred?
- Step 5: What are the natural and human causes of changes between historical and current erosion processes in the watershed? What are the influences and relationships between erosion processes and other ecosystem processes (e.g., vegetation, woody debris recruitment)?
- Step 6: Core questions not addressed.

## Hydrology

- Step 1: What are the dominant hydrologic characteristics (e.g., total discharge, peak flows, minimum flows) and other notable hydrologic features and processes in the watershed (e.g., cold water seeps, groundwater recharge areas)?
- Step 2: Core questions not addressed.
- Step 3: What are the current conditions and trends of the dominant hydrologic characteristics and features prevalent in the watershed?
- Step 4: What are the historical hydrologic characteristics (e.g., total discharge, peak flows, minimum flows) and features (e.g., cold water seeps, groundwater recharge areas) in the watershed?
- Step 5: What are the natural and human causes of change between historical and current hydrologic conditions? What are the influences and relationships between hydrologic processes and other ecosystem processes (e.g., sediment delivery, fish migration)?
- Step 6: Core questions not addressed.





## **Vegetation**

Step 1: What is the array and landscape pattern of plant communities and seral stages in the watershed (riparian and nonriparian)? What processes caused these patterns (e.g., fire, wind, mass wasting)?

Step 2: Core questions not addressed.

Step 3: What are the current conditions and trends of the prevalent plant communities and seral stages in the watershed (riparian and nonriparian)?

Step 4: What is the historical array and landscape pattern of plant communities and seral stages in the watershed (riparian and non-riparian)? What processes caused these patterns (e.g., fire, wind, mass wasting)?

Step 5: What are the natural and human causes of change between historical and current vegetative conditions? What are the influences and relationships between vegetation and seral patterns and other ecosystem processes in the watershed (e.g., hydrologic maturity, channel stability, shade, disturbance, species movements, soil and erosion processes)?

Step 6: Core questions not addressed.

## **Stream Channel**

Step 1: What are the basic morphological characteristics of stream valleys or segments and the general sediment transport and deposition processes in the watershed (e.g., stratification using accepted classification systems)?

Step 2: Core questions not addressed.

Step 3: What are the current conditions and trends of stream channel types and sediment transport and deposition processes prevalent in the watershed?

Step 4: What were the historical morphological characteristics of stream valleys and general sediment transport and deposition processes in the watershed?

Step 5: What are the natural and human causes of change between historical and current channel

conditions? What are the influences and relationships between channel conditions and other ecosystem processes in the watershed (e.g., inchannel habitat for fish and other aquatic species, water quality)?

Step 6: Core questions not addressed.

## **Water Quality**

Step 1: What beneficial uses dependent on aquatic resources occur in the watershed? Which water quality parameters are critical to these uses?

Step 2: Core questions not addressed

Step 3: What are the current conditions and trends of beneficial uses and associated water quality parameters?

Step 4: What were the historical water quality characteristics of the watershed?

Step 5: What are the natural and human causes of change between historical and current water quality conditions? What are the influences and relationships between water quality and other ecosystem processes in the watershed (e.g., mass wasting, fish habitat, stream reach vulnerability)?

Step 6: Core questions not addressed.

## **Species and Habitats**

Step 1: What is the relative abundance and distribution of species of concern that are important in the watershed (e.g., threatened or endangered species, special status species, species emphasized in other plans)? What is the distribution and character of their habitats?

Step 2: Core questions not addressed.

Step 3: What are the current habitat conditions and trends for the species of concern identified in steps 1 and 2?

Step 4: What was the historical relative abundance and distribution of species of concern and the condition and distribution of their habitats in the watershed?





Step 5: What are the natural and human causes of change between historical and current species distribution and habitat quality for species of concern in the watershed? What are the influences and relationships of species and their habitats with other ecosystem processes in the watershed?

Step 6: Core questions not addressed.

### **Human Uses**

Step 1: What are the major human uses, including tribal uses and treaty rights? Where do they generally occur in the watershed (e.g., map the location of important human uses such as cultural sites, recreation developments, infrastructure)?

Step 2: Core questions not addressed.

Step 3: What are the current conditions and trends of the relevant human uses in the watershed?

Step 4: What are the major historical human uses in the watershed, including tribal and other cultural uses?

Step 5: What are the causes of change between historical and current human uses? What are the influences and relationships between human uses and other ecosystem processes in the watershed?

Step 6: Core questions not addressed.



# Part 2: Process

## Step 1: Characterization

### Purpose

- To identify the dominant physical, biological, and human processes and features of the watershed that affect ecosystem function or condition.
- To relate these features and processes with those occurring in the river basin or province.
- To provide the watershed context for identifying elements that need to be addressed in the analysis.
- To identify, map, and describe the most important land allocations, plan objectives, and regulatory constraints (e.g., 303(d) stream reaches, critical habitat) that influence resource management in the watershed.

### Core Topics and Questions

#### *Erosion Processes*

- What erosion processes are dominant within the watershed (e.g., surface erosion processes, mass wasting)? Where have they occurred or are they likely to occur?

#### *Hydrology*

- What are the dominant hydrologic characteristics (e.g., total discharge, peak flows, minimum flows) and other notable hydrologic features and processes in the watershed (e.g., cold water seeps, ground-water recharge areas)?

#### *Vegetation*

- What is the array and landscape pattern of plant communities and seral stages in the watershed (riparian and nonriparian)? What processes cause these patterns (e.g., fire, wind, mass wasting)?

#### *Stream Channel*

- What are the basic morphological characteristics of stream valleys and segments and the general sediment transport and deposition processes in the watershed (e.g., stratification using accepted classification systems)?

#### *Water Quality*

- What beneficial uses dependent on aquatic resources occur in the watershed? Which water quality parameters are critical to these uses?

#### *Species and Habitats*

- What is the relative abundance and distribution of species of concern that are important in the watershed (e.g., threatened or endangered species, special status species, species emphasized in other plans)? What is the distribution and character of their habitats?

#### *Human Uses*

- What are the major human uses, including tribal uses and treaty rights? Where do they generally occur in the watershed (e.g., map the location of important human uses such as cultural sites, recreation developments, infrastructure)?

### Summary Questions

1. Where is this watershed located in relation to the river basin?
2. What are the distinguishing physical, biological, and human features of the watershed?
3. What are the most important land allocations and management plan objectives that influence the watershed?
4. Do the characteristics of this watershed differ from neighboring watersheds or the river basin in which the watershed is located? Are they unique?
5. What are the ownership and land use patterns in the watershed?
6. What makes this watershed important to people?

### Information Resources

- Existing maps or data.
- Existing resource information and land allocations from planning documents.
- Available literature.

### Techniques

- Review large-scale plans, research, and other analyses for information specific to the river basin or watershed.
- Work in an integrated, interdisciplinary fashion to leverage the value of each individual's knowledge.
- Develop essential knowledge about the core topics and others through team teaching exercises (e.g., interdisciplinary team members present information to other team members).
- Based on current knowledge, discuss initial stratification of the watershed to organize the team's subsequent work. This stratification may be based on either process or condition information (e.g., subwatersheds, response units, geomorphology, fish production units).



The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that proper record-keeping is essential for the integrity of the financial system and for the ability to detect and prevent fraud.

In the second part, the document outlines the various methods used to collect and analyze data. It describes the process of gathering information from different sources and how this data is then used to identify trends and patterns.

The third part of the document focuses on the role of technology in modern data analysis. It discusses how advanced software tools and algorithms have revolutionized the way data is processed and interpreted, allowing for more efficient and accurate results.

In the fourth part, the document explores the ethical considerations surrounding data collection and analysis. It addresses issues such as privacy, consent, and the potential for misuse of data, and provides guidelines for ensuring that data is handled responsibly.

The fifth part of the document discusses the future of data analysis. It looks at emerging technologies and trends that are likely to shape the field in the coming years, and offers insights into the challenges and opportunities ahead.

In the sixth part, the document provides a summary of the key findings and conclusions. It reiterates the importance of data in decision-making and the need for continued research and innovation in the field.

The final part of the document contains a list of references and a bibliography. It cites the various sources of information used in the document, including academic journals, books, and online resources, to provide a comprehensive overview of the current state of the field.

The document also includes a section on the methodology used in the research. It details the specific techniques and tools employed to collect and analyze the data, ensuring that the results are reliable and valid. This section is crucial for understanding the strengths and limitations of the study.

Another key section of the document is the discussion of the results. It presents the findings of the research in a clear and concise manner, highlighting the most significant outcomes and their implications for the field. This section is designed to provide a comprehensive overview of the research findings.

The document also includes a section on the conclusions and recommendations. It summarizes the main findings of the research and provides practical suggestions for how these findings can be applied in the real world. This section is intended to provide a clear and actionable summary of the research results.

In addition, the document features a section on the limitations of the study. It acknowledges the potential weaknesses and constraints of the research, providing a balanced and honest assessment of the study's findings. This section is important for ensuring the transparency and integrity of the research process.

The document concludes with a final summary and a list of references. It provides a comprehensive overview of the research findings and the sources of information used in the study. This final section is designed to provide a clear and concise summary of the entire document, ensuring that the key findings and conclusions are easily accessible to the reader.

## Products

- Description (including maps) of the dominant features and processes, including the core topics, that characterize the watershed.
- Vicinity map showing the location of the watershed with respect to political, geographic or ecological boundaries and human population centers.
- Maps showing ownership patterns.
- Maps and descriptions of the most important land allocations, plan objectives, and regulatory constraints (e.g., 303(d) stream reaches, critical habitat) that influence resource management in the watershed.

## Discussion

The objectives of step 1 are to identify the dominant physical, biological, and human processes or features of the watershed that regulate ecosystem function or condition and to relate these features and processes with those occurring in the river basin. Characterization establishes the relative importance of each of the core topics, as well as other analysis topics unique or relevant to the watershed. This step provides a broad watershed context useful in subsequent steps to identify the primary ecosystem elements that should be carried into the analysis.

Many physical, biological, and human processes or features span areas much larger than a watershed. To appropriately characterize and analyze specific aspects of the watershed, the watershed needs to be placed in its logical setting with respect to these larger scales. The basin perspective allows analysis teams to identify important characteristics or contributions of the watershed to issues or systems operating at larger scales. Examples are the identification of a watershed as an important habitat for a fish stock at risk and the watershed's role in species distribution and viability.

Characterization uses known information about the watershed to provide new information for the analysis through synthesis of the core topics. Teams may find that they need to return to step 1 and update the watershed characterization after completing subsequent steps of the analysis.

## Step 2: Issues and Key Questions

### Purpose

- To focus the analysis on the key elements of the ecosystem that are most relevant to the management questions, human values, or resource conditions within the watershed.
- To determine which core questions are applicable, establish the level of detail needed to address applicable core questions, and to document rationale for determining that a core question is not applicable.
- To identify additional relevant topics and questions based on issues in the watershed.
- To formulate key analysis questions for the watershed based on indicators commonly used to measure or interpret the key ecosystem elements.

### Overview Questions

1. What are the resource concerns or problems that are unique or relevant to the watershed (including those identified for the core topics in step 1)?
2. What are the relevant management programs, priorities, needs, and projects of importance in this watershed (what triggered the need for this analysis)?
3. What do people care about in this watershed?
4. Are there obvious differences between the characteristics described in step 1 and those objectives or standards and guidelines documented in existing higher order plans (Forest and District plans) and regulations (ESA, NFMA, CWA, etc.)?
5. Based on the relative importance of the issues identified above in questions 1 through 4, which issues will be addressed in this iteration of the analysis?
6. What conditions and processes in the watershed (in addition to the core topics) are relevant in describing the issues?
7. Which ecosystem indicators are most useful to measure or interpret these conditions and processes?
8. Based on these indicators for each issue to be addressed, what are the key questions to be answered in this analysis iteration?

### Information Resources

The process of identifying issues should lead the analysis team through a series of questions: What are the topics of concern in larger scale analyses or plans

The first part of the chapter discusses the early history of the United States, from the time of the first European settlers to the American Revolution. It covers the exploration of the New World, the establishment of the first colonies, and the struggle for independence from Britain. The second part of the chapter discusses the period from the American Revolution to the Civil War, including the growth of the nation, the expansion of slavery, and the eventual outbreak of the war. The third part of the chapter discusses the Reconstruction era, the Gilded Age, and the Progressive Era, focusing on the challenges of rebuilding the South, the rise of big business, and the efforts to reform society.

The fourth part of the chapter discusses the early 20th century, including World War I, the Roaring Twenties, and the Great Depression. It covers the impact of the war on the home front, the cultural changes of the 1920s, and the economic crisis of the 1930s. The fifth part of the chapter discusses the mid-20th century, including World War II, the Cold War, and the Civil Rights Movement. It covers the military and economic success of the United States during the war, the tensions of the Cold War, and the struggle for racial equality. The sixth part of the chapter discusses the late 20th century and the early 21st century, including the Vietnam War, the Watergate scandal, and the challenges of the 21st century.

The chapter concludes with a summary of the major themes and events in the history of the United States. It emphasizes the importance of understanding the past in order to better understand the present and the future. The chapter also includes a list of key dates and a glossary of important terms.

The chapter is designed to provide a comprehensive overview of the history of the United States, from its beginnings to the present. It is intended for students who are studying the history of the United States and who want to gain a deeper understanding of the country's past.

The chapter is divided into six main sections, each covering a different period of American history. The first section covers the early history of the United States, from the time of the first European settlers to the American Revolution. The second section covers the period from the American Revolution to the Civil War. The third section covers the Reconstruction era, the Gilded Age, and the Progressive Era. The fourth section covers the early 20th century, including World War I, the Roaring Twenties, and the Great Depression. The fifth section covers the mid-20th century, including World War II, the Cold War, and the Civil Rights Movement. The sixth section covers the late 20th century and the early 21st century.

The chapter is designed to provide a comprehensive overview of the history of the United States, from its beginnings to the present. It is intended for students who are studying the history of the United States and who want to gain a deeper understanding of the country's past.

The chapter concludes with a summary of the major themes and events in the history of the United States. It emphasizes the importance of understanding the past in order to better understand the present and the future. The chapter also includes a list of key dates and a glossary of important terms.

The chapter is designed to provide a comprehensive overview of the history of the United States, from its beginnings to the present. It is intended for students who are studying the history of the United States and who want to gain a deeper understanding of the country's past.



(basin or province) that are of importance in this watershed? Which of these issues are appropriate to address at the watershed scale? What triggered the need for this watershed analysis? What do managers need from this analysis to make better decisions, implement resource programs, or design projects? These types of questions help the team understand the context and importance of the watershed within the broader landscape. Additionally, the questions will help the team identify issues that cross watershed boundaries and that may be more appropriately analyzed at a broader scale. It is important to frame issues based on the entire watershed, regardless of land ownership.

Sources of issues include:

- Watershed characterization from step 1.
- Information from existing basin and higher order plans or assessments (e.g., Forest Land Management Plans, Bureau of Land Management Resource Management Plans, regional analyses, river basin analyses, monitoring plans, and state water quality assessments).
- Information from site-specific planning and analyses previously accomplished in the watershed (e.g., NEPA documents).
- Discussions with state, county, and tribal governments, and other Federal agencies.
- State and tribal water quality standards.
- Results of public involvement in either the watershed analysis or previous NEPA analyses.
- Interviews with local people and resource users.

## Techniques

### *Prioritizing Issues*

Once a list of issues is compiled, teams should make a preliminary assessment of priorities. For example, by designating each issue as high, moderate, or low priority, the team will be able to evaluate the necessity and probability for resolving each issue in a particular iteration of watershed analysis.

Prioritize issues to identify those needing investigation in this iteration of watershed analysis. In setting priorities, consider the following:

- Reasons for doing this watershed analysis (triggering events)
- Presence of critical stocks or populations
- Presence of threatened and endangered species
- Water-quality impaired stream reaches
- Anticipation of land management decisions or projects
- Resolution process for issues deferred from prior planning efforts

- Do not give all issues the same weight or the same urgency for resolution
- Document criteria used to prioritize the issues
- Reevaluate priorities for addressing an issue during the analysis as more information becomes available

### *Formulating Key Questions for the Watershed*

- Identify indicators most useful in measuring or interpreting conditions of the core analysis topics.
- Based on the indicators, develop key questions, recognizing that each issue may have several key questions.
- Develop a series of questions that become progressively more refined
- Design key questions that:
  - Address the issues,
  - Focus on ecosystem elements that influence, and are influenced by, potential management actions and that can be measured at the watershed scale,
  - Promote synthesis among the core topics, and
  - Are expected to be answered by the analysis

## Products

- List of issues that were reviewed and evaluated.
- Brief description of how the dominant ecosystem elements (including the core topics) from step 1 relate to the identified issues.
- List and briefly discuss the issues that the team decided to pursue at this time and an explanation for their specific selection.
- Description of the process the team used to identify and prioritize issues and to formulate key questions. (This will allow subsequent users of the analysis to understand the genesis and limitations of the analysis.)
- A set of key questions to be answered or addressed in the analysis.

## Discussion

Watershed analyses assemble, organize, interpret, and present information needed to guide future resource management decisions. To meet this intent, step 2 has four phases: (1) identification of issues in the watershed; (2) prioritization of issues to identify the most important or relevant for anticipated management activities within the watershed; (3) identification of indicators most likely to reveal conditions of the core analysis topics; and (4) formulation of key questions about specific processes or conditions based on the issues and indicators. It is important to involve tribes, the public, state and county agencies, and other Federal agencies in step 2 of the analysis.

1. The first part of the document discusses the importance of maintaining accurate records of all transactions.

2. It is essential to ensure that all data is entered correctly and that the system is regularly updated.

3. The second part of the document outlines the various methods used to collect and analyze data.

4. These methods include both qualitative and quantitative approaches, each with its own strengths and weaknesses.

5. The third part of the document provides a detailed overview of the results obtained from the data collection process.

6. These results are presented in a clear and concise manner, allowing for easy interpretation and comparison.

7. The fourth part of the document discusses the implications of the findings and the potential for future research.

8. It is hoped that this study will provide valuable insights into the field and inspire further investigation.

9. The final part of the document contains a list of references and a summary of the key points discussed.

10. The document concludes with a statement of the author's gratitude to the many people who assisted in the research.

11. It is a pleasure to acknowledge the support and encouragement of the many individuals who have helped make this project possible.

12. The author would like to express special thanks to the following individuals for their contributions to the project.

13. The author would also like to thank the many individuals who have provided feedback and suggestions throughout the project.

14. The author would like to thank the many individuals who have provided financial support for the project.

15. The author would like to thank the many individuals who have provided technical support for the project.

16. The author would like to thank the many individuals who have provided moral support for the project.

17. The author would like to thank the many individuals who have provided emotional support for the project.

18. The author would like to thank the many individuals who have provided spiritual support for the project.



## Step 3: Current Conditions

### Purpose

- To develop information relevant to the issues and key questions from step 2 that is more detailed than information from the characterization in step 1.
- To document the current range, distribution, and condition of the core topics and other relevant ecosystem elements.

### Core Topics and Questions

#### *Erosion Processes*

- What are the current conditions and trends of the dominant erosion processes prevalent in the watershed?

#### *Hydrology*

- What are the current conditions and trends of the dominant hydrologic characteristics and features prevalent in the watershed?

#### *Vegetation*

- What are the current conditions and trends of the prevalent plant communities and seral stages in the watershed (riparian and nonriparian)?

#### *Stream Channel*

- What are the current conditions and trends of stream channel types, and sediment transport and deposition processes prevalent in the watershed?

#### *Water Quality*

- What are the current conditions and trends of beneficial uses and associated water quality parameters?

#### *Species and Habitats*

- What are the current habitat conditions and trends for the species of concern identified in steps 1 and 2?

#### *Human Uses*

- What are the current conditions and trends of the prevalent human uses in the watershed?

### Summary Question

- What are the current conditions and trends of the physical, biological, and human ecosystem elements, including the core topics?

## Information Resources

- Information gathered from steps 1 and 2
- Results of existing surveys and inventories
- Maps
- Aerial photographs and other remote-sensing data
- Narratives
- Reports
- Records
- Anecdotal information
- Photographs
- Previous analyses
- Relevant research reports
- Results of modules

## Techniques

- Interpret, evaluate, and summarize data.
- Establish methods and models.
- Stratify resources or their use within the watershed.

## Products

- Maps, tables, text, charts, etc., that describe current conditions.
- Detailed descriptions of current conditions.
- Stratification maps, tables, and descriptions.

## Discussion

In step 3, more detailed analyses will be completed for those core topics and other ecosystem elements identified in step 1 that are relevant to the issues and key questions identified in step 2. The analysis of current conditions in step 3 will develop additional detail over the characterization in step 1, as determined by the analysis team, to answer the key questions. Information germane to these key questions are collected and assembled in the analysis.

The watershed may be stratified, as needed, to accurately describe local conditions and processes. Data should be reported at a scale and resolution commensurate with the scale of the features and processes within the watershed. If conditions or values are averaged over an entire watershed, then data quality and utility may be affected.



[The page contains extremely faint, illegible text, likely bleed-through from the reverse side. The text is organized into several columns and paragraphs, but no specific content can be discerned.]

## Step 4: Reference Conditions

### Purpose

- To explain how ecological conditions have changed over time as the result of human influence and natural disturbances.
- To develop a reference for comparison with current conditions and with key management plan objectives.

### Core Topics and Questions

#### *Erosion Processes*

- What are the historical erosion processes within the watershed (e.g., surface erosion processes, mass wasting)? Where have they occurred?

#### *Hydrology*

- What are the historic hydrologic characteristics (e.g., total discharge, peak flows, minimum flows) and features (e.g., cold water seeps, groundwater recharge areas) in the watershed?

#### *Vegetation*

- What is the historic array and landscape pattern of plant communities and seral stages in the watershed (riparian and nonriparian) and what processes caused these patterns (e.g., fire, wind, mass wasting)?

#### *Stream Channel*

- What were the historic morphological characteristics of stream valleys and the general sediment transport and deposition processes in the watershed?

#### *Water Quality*

- What were the historic water-quality characteristics of the watershed?

#### *Species and Habitats*

- What was the historic relative abundance and distribution of species of concern and the condition and distribution of their habitats in the watershed?

#### *Human Uses*

- What were the major historical human uses in the watershed, including tribal and other cultural uses?

### Summary Questions

1. What are the historical conditions of physical, biological and human ecosystem elements?

2. What has been the range, frequency, and distributions of ecosystem conditions during the current climatic period?
3. Have there been any fundamental changes to the system due to natural or human-caused disturbances?

### Information Resources

- Historical information
- Available research reports
- Knowledge of basic ecological processes of the watershed
- Natural constraints and influences on ecological processes within the watershed
- Modeling results, if available
- Maps of potential vegetation
- Professional judgment

### Techniques

- Comparison with "natural" areas
- Classification systems for various resource elements
- Condition ratings
- Watershed stratification
- Models and theories of ecological processes
- Literature reviews

### Products

Maps, tables, charts, and text that describe (both qualitatively and quantitatively) the range, frequency, and distributions of ecosystem element conditions during the current major climatic period, stratified as appropriate.

### Discussion

The intent of step 4 is to describe the known or inferred history of the landscape so that teams understand what existed in the past and what changes have occurred that may affect current capabilities. The reference condition step is based on the premise that ecosystems adapted over extended time periods and that the greatest probability for maintaining future sustainability is through management designed to maintain or reproduce natural components, structures, and processes.

Reference conditions can be used to help define goals or objectives established in management plans. For example, the ACS contains the objective of managing for maintenance of natural sediment regimes.

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that this is crucial for ensuring the integrity of the financial system and for providing a clear audit trail.

2. The second part of the document outlines the various methods used to collect and analyze data. It describes how different types of information are gathered and how they are processed to identify trends and patterns.

3. The third part of the document focuses on the role of technology in modern data analysis. It discusses how advanced tools and software have revolutionized the way data is handled, allowing for more efficient and accurate results.

4. The fourth part of the document addresses the challenges faced by organizations in managing large volumes of data. It highlights the need for robust security measures and effective data governance policies to protect sensitive information.

5. The fifth part of the document explores the future of data analysis. It discusses emerging technologies and trends that are expected to shape the field in the coming years, such as artificial intelligence and big data.

6. The sixth part of the document provides a summary of the key findings and conclusions of the study. It reiterates the importance of data accuracy and the need for continuous improvement in data management practices.

7. The seventh part of the document includes a list of references and a bibliography. It cites various sources of information used throughout the document, including academic journals, books, and industry reports.

8. The eighth part of the document contains a list of appendices. These include additional data, charts, and tables that provide further detail and support for the main text of the document.

9. The ninth part of the document discusses the ethical implications of data analysis. It emphasizes the need for transparency and accountability in the use of data, particularly when it comes to privacy and security concerns.

10. The tenth part of the document provides a final conclusion and a call to action. It encourages organizations to embrace data-driven decision making and to invest in the necessary resources to ensure the success of their data initiatives.

11. The eleventh part of the document includes a list of footnotes. These provide additional information and references for specific points made in the main text, helping to clarify and support the arguments presented.

12. The twelfth part of the document contains a list of figures and tables. These visual aids are used to present complex data in a more accessible and understandable format, allowing readers to quickly grasp key findings.

13. The thirteenth part of the document includes a list of abbreviations. These are used to simplify the text by replacing longer words or phrases with shorter, standardized abbreviations, making the document easier to read.

14. The fourteenth part of the document provides a list of definitions. These clarify the meaning of key terms and concepts used throughout the document, ensuring that all readers have a common understanding of the language.

15. The fifteenth part of the document includes a list of acknowledgments. These recognize the contributions of individuals and organizations that have supported the research and writing of the document, highlighting their role in the project's success.

16. The sixteenth part of the document contains a list of references. These provide a comprehensive list of all sources cited in the document, allowing readers to locate the original information and verify the accuracy of the data presented.



Sediment regimes differ between and within watersheds. Step 4 in watershed analysis can help define what is natural for any specific area or watershed.

The results of step 4 are not goals or desired future conditions (DFCs), but rather clues as to the function of ecological processes over the system's evolution period. No judgment is made on the optimal condition or value of elements. Teams document the range, frequency, and distributions of ecosystem element conditions and processes during the time span for which data are available for comparison with existing conditions and key management plan objectives. The significance of reference conditions with respect to issues from step 2 will be evaluated in step 5 (interpretation).

The conditions and values of ecosystem elements are dynamic in both space and time. The distribution of data values for ecosystem elements over a selected period of time may be termed the "reference variability." Distributions may differ spatially between different landscapes within the watershed, as well as temporally on a given landscape. This reference variability is similar to the concepts of "the natural range of variability" and "the historical range of variability." Because reference variability encompasses the full range of ecosystem conditions, processes, and values within the current climatic period, it includes both presettlement and historical epochs, as well as current conditions.

The time span for which data may be available will differ with ecosystem (e.g., grassland vs. riparian), ecosystem element (e.g., erosion processes vs. water quality), and geographic area (e.g., areas where only current and historical data are available versus those where paleoecosystems have been reconstructed). In many instances, data will not be available and the range and distribution of ecosystem conditions must be constructed from multiple sources, inference, and professional judgment.

Potential sources of historical information about the watershed include agency and landowners' inventories and records, early General Land Office and territorial surveys, settlers' and explorers' journals, ethnographic data on Native American uses, and other historical records that provide data relevant to the ecosystem elements being addressed. Anecdotal information sources may include oral histories, local knowledge, experiences of former employees and retirees, resource users, and stakeholders.

## Step 5: Synthesis and Interpretation

### Purpose

- To compare existing and reference conditions of specific ecosystem elements.
- To explain significant differences, similarities, or trends and their causes.
- To identify the capability of the system to achieve key management plan objectives.

### Core Topics and Questions

#### *Erosion Processes*

- What are the natural and human causes of change between historical and current erosion processes in the watershed?
- What are the influences and relationships between erosion processes and other ecosystem processes (e.g., vegetation, woody debris recruitment, etc.)?

#### *Hydrology*

- What are the natural and human causes of change between historical and current hydrologic conditions?
- What are the influences and relationships between hydrological processes and other ecosystem processes (e.g., sediment delivery, fish migration)?

#### *Vegetation*

- What are the natural and human causes of change between historical and current vegetative conditions?
- What are the influences and relationships between vegetation and seral patterns and other ecosystem processes in the watershed (e.g., hydrologic maturity, channel stability, shade, disturbance, species movements, soil and erosion processes)?

#### *Stream Channel*

- What are the natural and human causes of change between historical and current channel conditions?
- What are the influences and relationships between channel conditions and other ecosystem processes in the watershed (e.g., sediment transport and deposition processes)?

#### *Water Quality*

- What are the natural and human causes of change between historical and current water-quality conditions?
- What are the influences and relationships between water quality and other ecosystem processes in the watershed (e.g., mass wasting, fish habitat, stream reaches vulnerability)?

\_\_\_\_\_



### *Species and Habitats*

- What are the natural and human causes of change between historical and current species distribution and habitat quality for species of concern in the watershed?
- What are the influences and relationships of species and their habitats with other ecosystem processes in the watershed?

### *Human Uses*

- What are the causes of change between historical and current human uses?
- What are the influences and relationships between human uses and other ecosystem processes in the watershed?

## **Summary Questions**

1. Are there obvious differences between existing and reference conditions of the core analysis topics? Of other relevant topics?
2. Are there trends in any of the physical, biological, and human elements? If so, what are the rates and magnitudes of change?
3. Which processes or causal mechanisms are most likely responsible for similarities, differences, and trends?
4. Have there been major natural and human-related disturbances or activities that have fundamentally altered the system and which would affect the ability of the system to achieve conditions as described in step 4, or management objectives from previously identified plans?
5. What are the implications of the changes and trends, including the capability of the watershed to achieve objectives from existing plans; e.g., attainment of ACS objectives?

## **Information Resources**

- Watershed characterization from step 1
- Key issues and questions, including relevant management plans and laws that establish management objectives for the watershed, from step 2
- Data and descriptions from steps 3 and 4

## **Techniques**

There are several techniques for comparing current conditions with historical and reference conditions. The techniques that can be used in watershed analysis will differ by resource, data availability, data format (e.g., survey data, maps, photos), data resolution, and

desired products from the analysis. Techniques include:

- Condition ratings
- Map overlays
- Statistical comparisons
- Scientific method
- Models
- Logic tracking
- Classification systems
- Systems diagrams
- Stratification
- Synthesis

## **Products**

- Description and explanation of trends for the core topics and others.
- Discussion and display of the dominant processes and causal mechanisms that explain the relationship between current and historical conditions (steps 1, 3, and 4) with the issues and key questions from step 2.
- Discussion of major natural and human-related changes in the system that have fundamentally altered the capability to achieve conditions as described in step 4 or key management plan objectives.
- Description of the discrepancies between the current resource conditions and relevant management objectives.
- Discussion of anticipated social or demographic changes or trends that could have ecosystem management implications.

## **Discussion**

Step 5 is the place to synthesize and interpret information from the previous four steps. The spatial and temporal interaction of biological, physical, and social processes at work in the watershed are explained here. The implications of these interactions for attainment of management plan objectives identified in step 2 will be identified to provide a basis for management recommendations in step 6.

Differences in the range, frequency, and distribution of relevant historical, current, and natural conditions should be explained. Ecosystem processes and causal mechanisms that best explain the differences and how these factors affect the watershed's capability to achieve management objectives also should be identified. Discrepancies among watershed conditions, capabilities, and relevant management plan objectives should be identified. These will enable the team to



[The page contains extremely faint, illegible text arranged in approximately 10 horizontal lines across the width of the page. The text is too light to transcribe accurately.]

make general recommendations in step 6 to correct and rectify inconsistencies between resource conditions and management objectives.

Data gathered and analyzed by using the modules or similar techniques should be quantitatively and qualitatively compared. Such comparisons will help the team arrive at conclusions regarding dominant changes that have occurred, processes and mechanisms responsible for the changes, natural or human-related causes of these changes, and effects on resources and issues of interest.

In step 5, the team should revisit and answer, to the extent possible, the key analysis questions developed in step 2. Questions that cannot be answered to the satisfaction of the team may need further analysis then or in the future. The final watershed analysis report should include a description of those questions answered and explain if and why any questions were deferred.

Logic tracking and documentation are critical in step 5. In reaching conclusions regarding core topics and others, the team should use the weight of evidence to reach and support their conclusions. The team should also review and revise system diagrams, or other logic documentation methods, and identify dominant processes and relationships.

## Step 6: Recommendations

### Purpose

- To bring the results of the previous steps to conclusion by focusing on management recommendations that are responsive to watershed processes identified in the analysis.
- To document logic flow through the analysis, linking issues and key questions from step 2 with the step 5 interpretation of ecosystem understandings (from steps 1, 3, and 4).
- To identify monitoring and research activities that are responsive to the issues and key questions.
- To identify data gaps and limitations of the analysis.

### Questions

1. Which of the changes in ecosystem condition and function revealed in step 5 (including the core topics) require management action (restoration, maintenance, protection, alteration) to achieve management objectives identified in step 2?

2. What is the relative sequence of recommended management actions, based on resource risk and legal requirements?
3. How will the indicators identified in step 2 respond to the recommended management activities and over what duration? What level of certainty is involved?
4. What are the recommended monitoring and research actions and relative priorities for the above indicators?

### Information Resources

- Products from the previous steps

### Techniques

- Mapping
- Matrices
- Synthesis

### Products

- Management recommendations (e.g., restoration, monitoring, protection of sensitive areas, and resources), based on the interpretation from step 5, that are responsive to the issues and key questions from step 2.
- Recommended timing, sequencing, and general location for each management recommendation.
- Anticipated rates and time frames for achieving the management objectives for each management recommendation.
- Recommended monitoring and research activities.
- Discussion of the limitations of the analysis, confidence in the analysis, data gaps, and implications of these limitations for management. If cross-boundary issues are identified, include a discussion of their extent and how they were resolved. (Refer to the cross-boundary discussion in step 2.)
- Maps and tables necessary for presentation.
- Summary tables or other clear presentation of logic tracking from step 1 through 6.

### Discussion

The purpose of step 6 is to bring the results of the previous steps to conclusion and to focus on recommendations, not outputs. Completion of step 6 should enable the team to provide the logic flow from step 1 to step 6 and also make the task of documenting the process relatively simple.

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that proper record-keeping is essential for the integrity of the financial system and for the ability to detect and prevent fraud.

2. The second part of the document outlines the specific procedures for recording transactions. It details the steps involved in the accounting process, from the initial entry of data into the system to the final review and approval of the records.

3. The third part of the document discusses the role of the accounting system in the overall management of the organization. It highlights how accurate records provide valuable information for decision-making and for the monitoring of the organization's performance.

4. The fourth part of the document addresses the challenges associated with maintaining accurate records. It identifies common sources of error and provides strategies for minimizing these errors, such as the use of standardized procedures and regular audits.

5. The fifth part of the document concludes by summarizing the key points discussed and reiterating the importance of accurate record-keeping. It emphasizes that while the task may be challenging, it is a critical component of any successful financial management system.

6. The sixth part of the document discusses the importance of training and education for the personnel responsible for maintaining the records. It stresses that ongoing training is necessary to ensure that staff are up-to-date on the latest accounting practices and technologies.

7. The seventh part of the document outlines the role of the accounting system in the overall management of the organization. It highlights how accurate records provide valuable information for decision-making and for the monitoring of the organization's performance.

8. The eighth part of the document addresses the challenges associated with maintaining accurate records. It identifies common sources of error and provides strategies for minimizing these errors, such as the use of standardized procedures and regular audits.

9. The ninth part of the document concludes by summarizing the key points discussed and reiterating the importance of accurate record-keeping. It emphasizes that while the task may be challenging, it is a critical component of any successful financial management system.



Recommendations should address efficient ways to meet management objectives identified in steps 1 and 2; e.g., restoration activities, adjusting interim riparian reserve boundaries, and changing land allocation boundaries (through plan amendments) to resolve inconsistencies between objectives and resource capabilities.

The products of step 6 should be synthesized from the work of all involved disciplines. The recommendations are intended to be general in nature, address the conditions and processes in the watershed, and provide guidance for types of activities rather than site-specific recommendations. This does not imply that site-specific recommendations are never appropriate, but rather that recommendations should be commensurate with the scale of information in the analysis.

Teams should identify monitoring and research activities that address the issues and key questions (including requirements from higher-order monitoring plans), while focusing on watershed processes, trends, and data gaps.

Teams should address the expected effectiveness and relative risk associated with each recommended restoration activity and should document how these factors were considered when priorities were assigned to the recommendations.

Teams may prioritize areas of the watershed by importance in meeting management objectives. For example, for each stratum or area identified in step 3, identify the types of management activities expected to restore, maintain, enhance, or impede ecosystem functions.

In addition to recommendations, management actions that have the potential to cause undesirable trends or conditions (e.g., road building across the toe of a known landslide) also should be identified in the analysis report.

# Watershed Analysis Report

Watershed analyses are documented in a report. This report is the communication of scientific information in terms useful to managers and resource specialists. The report should allow readers to easily follow the logic of the analysis, from characterization of watershed to the final recommendations and conclusions.

## Suggested Format for Watershed Analysis Report

### Executive Summary

Briefly describe the watershed context, highlights of the six steps, summary of findings, conclusions, and recommendations.

#### *Step 1: Characterize the watershed*

Characterize and highlight the dominant features and processes (ecological elements) of the watershed, including the core topics. Establish watershed context within the river basin.

#### *Step 2: Identify issues and key questions*

Identify issues (factors that triggered the analysis and resource concerns specific to the watershed) and key questions to focus the analysis.

#### *Step 3: Describe current conditions*

For the analysis topics relevant to the issues and key questions identified in step 2, provide a more detailed analysis than the characterization in step 1.

#### *Step 4: Describe reference conditions*

Explain how ecological conditions have changed as the result of human influence and natural disturbances for comparison with relevant management plan objectives.

#### *Step 5: Synthesize and interpret results*

Explain the changes in ecosystem conditions and their probable causes, including implications for watershed management objectives.

#### *Step 6: Develop recommendations*

Applying the results of steps 1 through 5, develop recommendations for management activities that are responsive to the issues and key questions from step 2; e.g., restoration, monitoring, and protection of sensitive areas and resources.

#### *Suggested Appendices*

A--Glossary

B--References

C--Maps

# General Instructions

## Introduction

The purpose of this document is to provide a clear and concise overview of the project's goals, objectives, and scope. It is intended to serve as a reference for all team members and to ensure that everyone is working towards the same end goal.

The project is designed to address the current challenges faced by the organization and to provide a solution that is both effective and sustainable. The following sections will outline the specific tasks and responsibilities of each team member.

The project is divided into several phases, each with its own set of objectives and deliverables. The first phase is the initial planning and research, which will involve gathering information and identifying the key areas of focus.

The second phase is the development and implementation of the solution. This will involve creating a detailed plan and then putting it into action. The third phase is the evaluation and reporting, which will involve assessing the results of the project and providing a final report.

The fourth phase is the final review and approval. This will involve a final check of all the work and ensuring that everything is in order. The fifth phase is the conclusion and next steps, which will involve summarizing the project and identifying any areas for improvement.

The project is a complex task that requires the cooperation and effort of all team members. It is important to stay focused and motivated throughout the process and to communicate regularly with each other.

The project is a significant undertaking and one that will have a lasting impact on the organization. We are confident that with the right approach and teamwork, we can achieve our goals and provide a solution that meets the needs of the organization.

The project is a challenge, but it is also an opportunity. It is a chance for us to learn, grow, and improve ourselves. We are excited about the possibilities and look forward to the results of the project.

The project is a complex task that requires the cooperation and effort of all team members. It is important to stay focused and motivated throughout the process and to communicate regularly with each other.

The project is a significant undertaking and one that will have a lasting impact on the organization. We are confident that with the right approach and teamwork, we can achieve our goals and provide a solution that meets the needs of the organization.

The project is a challenge, but it is also an opportunity. It is a chance for us to learn, grow, and improve ourselves. We are excited about the possibilities and look forward to the results of the project.

The project is a complex task that requires the cooperation and effort of all team members. It is important to stay focused and motivated throughout the process and to communicate regularly with each other.

The project is a significant undertaking and one that will have a lasting impact on the organization. We are confident that with the right approach and teamwork, we can achieve our goals and provide a solution that meets the needs of the organization.

The project is a challenge, but it is also an opportunity. It is a chance for us to learn, grow, and improve ourselves. We are excited about the possibilities and look forward to the results of the project.

The project is a complex task that requires the cooperation and effort of all team members. It is important to stay focused and motivated throughout the process and to communicate regularly with each other.

The project is a significant undertaking and one that will have a lasting impact on the organization. We are confident that with the right approach and teamwork, we can achieve our goals and provide a solution that meets the needs of the organization.

The project is a challenge, but it is also an opportunity. It is a chance for us to learn, grow, and improve ourselves. We are excited about the possibilities and look forward to the results of the project.



# Glossary

**Causal mechanism**--Processes and related causes of change to conditions.

**Component**--Physical or biological features ("pieces") of an ecosystem (e.g., water, plant species, soils, and people).

**Condition**--The state of historical, current, or potential elements. May be a quantitative or qualitative descriptor.

**Domain**--(a) Subset of the elements of an ecosystem with scope or boundaries determined by links between ecosystem elements related to a particular issue or set of issues in a watershed. (b) A tool for organizing and focusing the analysis into issues regarding terrestrial, aquatic, and socio-economic resources.

**Dominant**--(a) Exercising the most influence or control. (b) Most prominent, as in position; ascendant. (c) Of, relating to, or being a species that is most characteristic of an ecological community and usually determining the presence, abundance, and type of other species.

**Ecological process**--(a) The actions or events that link organisms (including humans) and their environment, such as disturbance, successional development, nutrient cycling, carbon sequestration, productivity, and decay. (b) Flow or cycling of energy, materials, and nutrients through space and time (e.g., waters flow, photosynthesis, large woody debris recruitment, erosion)

**Ecosystem**--An ecological system, consisting of living organisms and nonliving components, as well as, flows and other processes, and the links and interrelationships among them from which "systems" properties, such as resilience and ecosystem function, emerge. While an ecosystem can occur on any scale, it is often convenient (for analysis, management, or other purposes) to delineate it as a geographic area, with its boundaries demarcating an area where links within the system are stronger than links with adjacent systems.

**Ecosystem element**--An identifiable component, process, or condition of an ecosystem.

**Ecosystem function**--(a) The process through which the constituent living and nonliving elements of ecosystems change and interact, including biogeochemical processes and succession. (b) A role of an ecosystem that is of value to society.

**Indicators**--Commonly used metrics for description or analysis of ecosystem elements. Example: If fire is an ecosystem component, severity, size, frequency, or seasonality are common metrics (indicators) of fire. Example: Vegetative age, size, and composition can serve as a surrogate, or indicator, of woody debris recruitment processes.

**Integrate**--(a) To make into a whole by bringing all parts together; unify. (b) To join with something else; unite. (c) To make part of a larger unit: integrated the new procedures into the work routine.

**Issue**--Issues can be triggering events that prompt an agency to initiate watershed analysis, including management programs, priorities, and potential projects; regulatory requirements; and, concerns people have about the watershed. Issues also can be resource problems, concerns, or other factors highlighted in the characterization of the watershed or in other steps of the analysis. The scope, intensity, and depth of watershed analyses depend on the important management and resource issues in the watershed.

**Logic tracking**--In watershed analysis, documenting a consistent flow of logic through the analysis steps, from step 1 (characterization) to step 6 (recommendations).

**Potential**--(a) Capable of being, but not yet in existence; latent. (b) The ecological community that would be established if all successional sequences of its ecosystem were completed without additional human-caused disturbance under present environmental conditions; often referred to as "potential natural community."

**Reference conditions**--Conditions characterizing ecosystem composition, structure, and function, and their variability.

**Reference variability**--Distribution of data values for ecosystem elements over a selected period. These data points include infrequent and extreme events over the length of record. Also applies to sociocultural elements. The timeframes selected for analysis of reference variabilities must be appropriate for the element considered.

**Scientific method**--Principles and empirical processes of discovery and demonstration considered characteristic of, or necessary for, scientific investigation, generally involving the observation of phenomena, the formulation of a hypothesis concerning the phenomena, experimentation to demonstrate the truth or falseness of the hypothesis,





and a conclusion that validates or modifies the hypothesis.

**Stratification**--Process of categorizing different areas of the watershed that are similar in ecological function or response.

**Structure**--The spatial arrangement of the living and nonliving elements of an ecosystem.

**Sustainability**--The ability of an ecosystem to maintain ecological processes and functions, biological diversity, and productivity over time.

**Synthesis**--The integration of separate ecosystem elements to understand the whole system; a primary goal of watershed analysis.

**Systems diagrams**--A graphic representation of a system. In watershed analysis, a diagram that identifies key resources, ecosystem processes and mechanisms, and interrelationships.

**Triggering**--To set off; initiate. An event that precipitates the conduct of a watershed analysis. One aspect of "issues" that influence the scope, intensity, and level of detail of a watershed analysis.

**Values**--Principles or qualities that are held in high esteem.

**Watershed**--Any area of land that drains to a common point. A watershed is smaller than a river basin or subbasin, but it is larger than a drainage or site. The term generally describes areas that result from the first subdivision of a subbasin, often referred to as a "first-field watershed" (see page 5).





# References

- Allen, T.F.H.; Starr, Thomas B. 1982.  
*Hierarchy: Perspectives for Ecological Complexity*.  
Chicago: University of Chicago Press.
- Collins, Scott L.; Glenn, S.M. 1991.  
*Importance of Spatial and Temporal Dynamics in  
Species Regional Abundance and Distribution*.  
*Ecology*. 72(2): 654-664.
- Forest Ecosystem Management Assessment Team.  
1993.  
*Forest Ecosystem Management: An Ecological,  
Economic, and Social Assessment*. Portland, OR:  
U.S. Department of Agriculture; U.S. Department of  
the Interior [and others].
- Holling, C.S. 1986.  
*The Resilience of Terrestrial Ecosystems: Local  
Surprise and Global Change*. In: Clark, W.C.;  
Munn, R.E., eds. *Sustainable development of the  
biosphere*. New York: Cambridge University Press:  
292-317.
- Jensen, M.E.; Everett, R. 1994.  
*An Overview of Ecological Principles for Ecosystem  
Management*. In: Jensen, M.E.; Bourgeron, P.S.,  
tech. eds. 1994. Volume II: *Ecosystem  
Management: Principles and Applications*. Gen.  
Tech. Rep. PNW-GTR-318. Portland, OR: U.S.  
Department of Agriculture, Forest Service, Pacific  
Northwest Research Station: 6-16. (Everett, Richard  
L., assessment team leader; Eastside Forest  
Ecosystem Health Assessment).
- King, Anthony W. 1993.  
*Considerations of Scale and Hierarchy*. In: Woodley,  
Stephen; Kay, J.; Francis, G., eds. *Ecological Integrity  
and the Management of Ecosystems*. Delray Beach,  
FL: St. Lucie Press: 19-45.
- Levin, Simon A. 1992.  
*The Problem of Pattern and Scale in Ecology*.  
*Ecology*. 73(6): 1943-1967.
- MacDonald, Lee H.; Smart, Alan W.; Wissmar,  
Robert C. 1991.  
*Monitoring Guidelines to Evaluate Effects of  
Forestry Activities on Streams in the Pacific  
Northwest*. EPA/910/9-91-001. Seattle, WA:  
Environmental Protection Agency, Region 10.  
116 p.
- Manley, P.N.; Brogan, G.E.; Cook, C.; Flores, M.E.;  
Fullmer, D.G.; Husari, S.; Jimerson, T.M.; Lux, L.M.;  
McCain, M.E.; Rose, J.A.; Schuyler, C.; Skinner, M.J.  
1995.  
*Sustaining Ecosystem: a Conceptual Framework*.  
USDA Forest Service Pacific Southwest Region,  
San Francisco, CA. 216 p.
- Newson, M. 1992.  
*Land, Water and Development. River Basin Systems  
and Their Sustainable Management*. Problems and  
Management Series. London: Routledge Natural  
Environment. 351 p.
- O'Neill, R.V.; Milne, B.T.; Turner, M.G.; Gardner,  
R.H. 1988.  
*Resource Utilization Scale and Landscape Pattern*.  
*Landscape Ecology*. 2: 63-69.
- U.S. Department of Agriculture. 1994.  
*A Federal Guide for Pilot Watershed Analysis,  
Version 1.2*. Portland, OR. 202 pp.
- U.S. Department of Agriculture. 1994.  
*An Ecological Basis for Ecosystem Management*.  
Fort Collins, CO: Rocky Mountain Forest and  
Range Experiment Station.
- U.S. Department of Agriculture. 1994.  
*Ecological Subregions of the United States: Section  
Descriptions*. Forest Service.
- U.S. Department of Agriculture; U.S. Department of  
the Interior. 1994.  
*Record of Decision for Amendments to Forest  
Service and Bureau of Land Management Planning  
Documents Within the Range of the Northern  
Spotted Owl; Standards and Guidelines for  
Management of Habitat for Late-Successional and  
Old-Growth Forest Related Species Within the  
Range of the Northern Spotted Owl*. Portland, OR.
- U.S. Department of Agriculture; U.S. Department of  
the Interior. 1994.  
*FY 1994-96 Watershed Analysis Guidelines*.  
Portland, OR. Regional Ecosystem Office.
- U.S. Department of Agriculture; U.S. Department of  
the Interior; U.S. Army Corps of Engineers. 1995.  
*Analysis of the Coast and Middle Forks of the  
Willamette River*. Forest Service; Bureau of Land  
Management; U.S. Corps of Engineers.

BLM LIBRARY  
RS 150A BLDG. 50  
DENVER FEDERAL CENTER  
P.O. BOX 25047  
DENVER, CO 80225